

DEXTERITY EXAMINATIONS AS A PREADMISSION CRITERION IN DENTAL
HYGIENE PROGRAMS: A PHENOMENOLOGICAL STUDY

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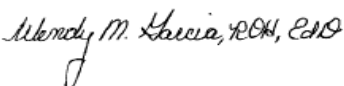

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Abstract

Clinical aptitude is a vital component of dental hygiene education and practice due to the dexterity needed to manipulate dental instruments for patient treatment and care. Preadmission criteria are primarily based on academic standards with a select few using dexterity examinations (DEs) as a preadmission requirement. This phenomenological research study examined the perceptions of dental hygiene program department chairs surrounding DEs as a preadmission requirement. The primary purpose of this study was to identify how DEs are used as a criterion for preadmission into dental hygiene programs, to identify any challenges and obstacles associated with their use and determine if DEs are perceived as a valid and reliable tool to assess the fine motor skills of dental hygiene applicants. Using semi-structured interviews, rich data was collected from eight participants. After performing a thematic analysis, several themes emerged surrounding the use of DEs as a preadmission criterion: participants knowledge of DEs, obstacles with implementation, positive impacts of implementation, student applicants have a lower level of dexterous ability, and perceived validity and reliability as an evaluative tool to assess the fine motor skills of applicants. The results of the research study uncovered insights and perspectives of dental hygiene program department chairs as to the use, feasibility of implementation, validity, and reliability of DEs. Results revealed reasons precluding programs from using DEs as a preadmission requirement which included: admissions, a large number of applicants to screen, and historical reasons. Programs that do use DEs as a preadmission requirement were able to offer guidance for other programs communicating their methods of implementation and the positive impacts administering DEs has had on their department. Positive impacts included identifying the dexterous ability of applicants, ease of use to administer, and reducing program attrition rates. This study has brought new information and

knowledge to the discipline of dental hygiene education and laid the foundation for future studies surrounding DEs and their ability to add additional methods of clinical assessment to current preadmission criteria.

Dedication

To my husband Chris, and my children Cole and Camryn. I thank you for your unconditional love, support, and understanding especially during the moments this journey has taken me away from time spent with all of you. I hope I have inspired you to follow your dreams, work hard, made you proud, and shown you can do anything you put your mind to at any age.

To my parents, I thank you for always believing in me and instilling the belief I could accomplish anything I set my mind to. Your support has been unwavering, your pride immense, and your love unconditional.

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Chapter 1: Introduction

Introduction to the Problem

The role of the dental hygienist is multifaceted and comprehensive requiring a multitude of skills to address the many modalities of patient care and treatment that is required. According to the American Dental Hygienists' Association (ADHA [2016b]), a dental hygienist is an oral health professional who is a graduate of an accredited dental hygiene program, licensed through a state of residence and is focused on the prevention and treatment of oral diseases as well as the promotion of oral and overall health. In addition to academic and mental acuity needed to succeed in this healthcare field, the dental hygienist must be proficient in manual dexterity, psychomotor skills, and hand function or hands-on ability to meet the clinical demands.

A major component of the role of a dental hygienist is the ability to manipulate both manual and powered dental instruments in an efficient, skillful, and safe manner. Clinical skill is needed for assessment of gingival and periodontal conditions, for removal of calculus deposits and the provision of periodontal therapy. Dental hygiene students must meet standards set forth by the Commission on Dental Accreditation (CODA), many of which are focused on attaining competency in clinical procedures. As such, dental hygiene programs are competency-based focusing on high academic standards and the ability of students to achieve competence in clinical processes. Some of the main principles of manual dental hygiene instrumentation are grasp, fulcrum, adaptation, angulation, stroke, and activation (Bowen & Piernen, 2019, pp. 442-451). Grasp can be described as the specific manner in which the hygienist places his or her fingers on the instrument; fulcrum as the support that is given to the hand to aid with instrument stroke and stability; adaptation as the correct placement and alignment of the instrument onto the tooth surface; angulation as the relationship between the working end of the instrument and the tooth

surface; stroke as the advancement of the instrument across the tooth surface; and activation as the multifunctional motion that allows movement of the working end of the instrument across the tooth surface (Bowen & Piernen, 2019, pp. 442-451). Without clinical competence in all principles, the dental hygiene student may not progress successfully through the program and require remediation or possible dismissal from the program.

According to the ADHA (2014), there are approximately 335 accredited dental hygiene programs in the United States (U.S.). Applicants are accepted annually with most dental hygiene programs having a maximum enrollment cap thus accepting only a small number of students for enrollment each year. In 2014, the ADHA developed a dental hygiene education program informative document which included information on curricula, program, enrollment, and graduation information. This fact sheet states the mean number of admissions into baccalaureate and associate dental hygiene programs are approximately 28 and 30 students each year respectively, with program applicants often tripling that number at most institutions. Due to the high number of applicants, dental hygiene programs have rigorous admissions criteria. After reviewing the ADHA's 2018 list of accredited entry-level dental hygiene schools, admission criteria include, but are not limited to, overall GPA (grade point average), scores on the ACT (American College Test), SAT (Scholastic Achievement Test), DHAT (Dental Hygiene Aptitude Test), HSRT (Health Science Reasoning Test), CCTST (California Critical Thinking Skills Test), TEAS (Test of Essential Academic Skills), and the HOBET (Health Occupations Basic Entrance Test). Additional criteria may include prerequisite courses as well as applicant interviews, dexterity exams, personal essays, shadowing a dental hygienist in the field for a predetermined number of hours, and journaling about the experience (Moore, Carr, Kearney, & Cluter, 2016; Sanderson & Lorentzen, 2015).

The preadmission criteria used by dental hygiene programs vary by institution as there are no standardized preadmission criteria in place for accredited dental hygiene programs (ADHA, 2014). Typically, each program will decide to use only a few select criteria as part of the admission selection process. Common admission criteria include overall GPA and prerequisite scores, SAT and ACT scores, applicant interviews, essays, and professional shadowing to name a few (Sanderson & Lorentzen, 2015). According to the ADHA (2014), 70% of all dental hygiene programs use overall and science GPA (typically prerequisite work) as a means of admission criteria (p. 9).

Statement of the Problem

Psychomotor skill and manual dexterity are vital components of all dental hygiene programs and within the profession itself due to the hands-on nature of the work. Because of the limited number of applicants accepted into a program, the selection process, inclusive of admission criteria, should yield applicants who are most apt to be successful in the program. Academic success leads to high pass rates on national and regional clinical board examinations, while also keeping retention rates high and attrition rates low. As there are currently no universally defined variables used for admissions by dental hygiene programs on a national level, each institution is free to define its own admission criteria (ADHA, 2014, p. 8).

Dexterity examinations are seldom used as a preadmission criterion to assess the manual dexterity and psychomotor skills of potential dental hygiene applicants. In the U.S., only 3% percent of dental hygiene programs utilize a type of manual DE as part of their admissions process (Sullivan, Garner & Hardy, 2014, p. 247). Most programs have an admission process primarily based on academic tests such as overall GPA, prerequisite course grades, and the ACT and SAT scores. Academic scores, while important, are not necessarily a good, reliable or valid

predictor of an applicant's ability to succeed clinically in a dental hygiene program or as a means to predict clinical performance (Rudy, Singleton, Lewis & Quick, 2017, p. 24). Hence, additional methods of preadmission criteria that assess the fine motor skills of potential applicants are needed.

Purpose of the Proposed Study

The primary purpose of the study was to identify how DEs are used as a criterion for preadmission into dental hygiene programs. Additionally, the researcher sought to identify factors that impede the use of manual DEs as preadmission criteria in dental hygiene programs, as well as determine their feasibility of use. It is important to recognize barriers or challenges in place that may prevent the use and implementation of DEs. Similarly, it is essential to understand if their utilization is perceived as a valid and reliable tool in predicting the clinical success of students in dental hygiene programs. For the few programs that use DEs, acquiring knowledge about DE implementation and identifying ways to mitigate obstacles may provide direction and guidance for other dental hygiene programs.

Research Questions

The use of DEs as a preadmission criterion in accredited dental hygiene programs is diminutive, with only 3% reporting testing of fine motor skills as part of the admission process (Sullivan et al., 2014, p. 247). Developing an understanding as to use or underuse of DEs may provide insights as to the perceptions of dental hygiene program directors as it relates to the reliability, validity, and impediments that accompany DE implementation and utilization. The following research question and sub-questions will help guide the study:

Research Question

1. How are dexterity examinations used as a criterion for preadmission into accredited dental hygiene programs?

Research Sub Questions

1. What is the perception of program directors regarding the validity and reliability of dexterity examinations as a preadmission requirement?
2. What is the perception of program directors regarding the feasibility and use of implementing dexterity examinations in an accredited dental hygiene program?

Significance of the Proposed Study

Recognizing the fine motor dexterity skill of an applicant prior to admission can be beneficial in the dental hygiene applicant selection process (ADA, 2019b, p. 7). Often, applicants are accepted into dental hygiene programs who excel academically in didactic courses but struggle in pre-clinical and clinical courses because of an inability to translate theory to practical skills (Taft, Dotson, & Byington, 2015, p. 115). Determining how DEs are used as a criterion for preadmission into dental hygiene programs may be beneficial in uncovering potential challenges with their use and implementation. Recognizing these factors may allow dental hygiene programs to develop strategies to overcome the identified barriers and begin to incorporate DEs into the preadmission process successfully. DEs have been proven effective in the literature as identifying weak students who may have difficulty keeping up with the clinical rigors and demands of the curricula (Schwibbe, Kothe, Hampe & Kinrad, 2016; Segura, Halabi & Navarro, 2018; Sullivan et al., 2014). In addition, students can be identified as potentially

poor candidates for the rigors of a dental hygiene program or as students in need of remediation for clinical skills early in the program.

Due to the numerous applicant pools and maximum enrollment caps, dental hygiene programs strive to accept the most qualified applicants who will be successful in the program. According to Sanderson (2014), “institutions recognize the importance of program retention, as this is one of the measures used to assess program effectiveness for accreditation” (p. 235). Implementing DEs as part of the preadmissions process in dental hygiene programs may help identify students with low dexterous ability and potentially increase the number of successful students enrolled in a specific cohort. This can have beneficial effects such as, but not limited to, improving student retention rates, and reducing attrition rates at the institution and program level.

Much of the research surrounding DEs as a positive means to assess students’ clinical aptitude and/or success has been conducted in dental schools and not specifically dental hygiene schools. The literature about specific variables (such as DEs) relating to dental hygiene program admissions and the impact on student success in a clinical capacity is scant (Rudy et al., 2017; Sullivan et al., 2014). This study will add to the limited body of research about DEs as a preadmission criterion in dental hygiene programs.

Definition of Terms

Ability – “A general trait influenced by heredity and learning” (Oermann, 1990, p. 202).

American Dental Hygienists’ Association (ADHA) – The ADHA is a national organization established in 1923 that represents the professional interests of registered dental hygienists across the country (ADHA, 2017, para. 1).

Clinical competence – “The achievement of a predetermined level of special skill derived from education and experience in the clinical setting” (ADA, 2019a, para. 31).

Competent – The ADA (2019a) defines competent as, “the achievement of a predetermined level of special knowledge and skill derived from education, experience, and task completion” (para. 4). CODA’s Accreditation Standards for Dental Hygiene Education Programs (2017) further defines being competent as, “the levels of knowledge, skills, and values required by new graduates to begin the practice of dental hygiene” (p.11).

Commission on Dental Accreditation (CODA) – A national agency established in 1975 providing accreditation to all dental related programs. CODA outlines acceptable operation and performance standards needed to be achieved by programs and/or institutions and performs evaluations measuring program quality and compliance with set standards (ADHA, 2016b, p. 1).

Dexterity examination/dexterity test – A tool used to evaluate and gauge the manual dexterity skills of select candidates (Cleghorn, Brilliant, Kraglund, Seth & Garland, 2018, p. 878).

Hand function – The strength required to manipulate muscles, dexterity to execute detailed movements and hand-eye coordination when maneuvering objects (Taft et al., 2015, p. 115).

Manual dexterity - “The ability to use your hands in a skillful, coordinated way to grasp and manipulate objects and demonstrate small, precise movements” (American Dental Education Association, 2019, para, 2).

Preadmission/admission criteria – Methods used to select applicants for admittance into an academic program (Moore et al., 2016, p. 380). These terms are used interchangeably throughout the body of the dissertation.

Psychomotor skill – Skilled movements using fine and/or gross motor skills with the ability to transfer knowledge and skills in varying contextual areas (Hill, Fadel, Bialik, 2018, p. 8).

Assumptions, Limitations, Delimitations

Assumptions

An assumption can be described as, “beliefs in the proposed research that are necessary to conduct the research but cannot be proven” (Goes & Simon, 2015, p.1). In this study, it is assumed that the participants will answer questions honestly and truthfully. The researcher will ensure participants feel comfortable and forthcoming with their responses by assuring anonymity and preserving confidentiality in the discussion of data collection, analysis, and interpretation. It is also assumed that all program directors are from accredited dental hygiene institutions, in good standing with CODA, and are within the U.S. The researcher will ensure the dental hygiene programs are accredited through CODA by performing an inquiry search through the ADHA’s current list of accredited dental hygiene programs.

Limitations

A limitation can be described as certain constraints beyond the control of the researcher but has the potential to impact the outcome of the study (Goes & Simon, 2015, p.2). The study will explore one variable, DEs and not multiple cognitive and non-cognitive variables as a preadmission criterion for entrance into dental hygiene programs, to maintain a singular area of research focus. Due to the small sample size, there is limited generalizability as the data collected may not be representative of the thoughts and attitudes of all dental hygiene program administrators in the U.S. Moreover, the results may not be generalized to other healthcare disciplines and academic programs. In addition, due to the qualitative nature of this study, and

the organic interviewing of participants, a lack of replication of results may affect the validity and reliability of the study.

Delimitations

A delimitation can be described as, “the characteristics that arise from limitations in the scope of the study and by the conscious exclusionary and inclusionary decisions made during the development of the study plan...delimitations result from specific choices made by the researcher” (Goes & Simon, 2015, p.4). This study addressed the admission variable of manual dexterity and not address other variables such as academic test scores, applicant interviews or shadowing. To keep the study focused, including all variables would not be feasible making the study too broad in scope and depth. Additionally, due to the qualitative nature of the study, it is not feasible to interview all dental hygiene program directors on a national level. Therefore, an additional delimitation is the small sample size used in the study and the inability to generalize the results to all dental hygiene programs.

Chapter 1 Summary

Manual dexterity is a vital skill needed for the successful completion of a dental hygiene program and passing the clinical board examination required for licensure. If applicants are severely deficient in fine motor skills, there could be several negative effects on both the applicant and the academic institution. Such negative effects may include pre-clinic and clinical course failures, remediation of clinical skills, program dismissal, student stress, an increase in attrition and a decrease in retention at both the program and institutional level.

The courses in the dental hygiene curriculum are extremely content-intensive requiring dedication, sacrifice, time, money, effort, and mental strain. When students are not successful

and dismissed from the program due to failure to meet clinical competence, the impact can be devastating (Moore et al., 2016, p. 379). From an institution and program standpoint, losing students due to a lack of clinical aptitude can significantly compromise retention rates. Moore et al. (2016) found the three most common factors that played a role in student attrition in dental hygiene programs were failure to meet academic requirements, personal problems, and clinical skills (p. 382). DEs have been proven effective in the literature as identifying students with weak or low dexterous ability (Schwibbe et al., 2016; Segura et al., 2018; Sullivan et al., 2014). With only 3% of dental hygiene programs nationally using DEs as a means of preadmission criteria (Sullivan et al., 2014, p. 247), this study will help identify perceptions of DEs and their feasibility of use broadening this area of knowledge in the field.

Chapter 2: Literature Review

College admissions standards have been in place since Harvard College first developed requirements for admissions in 1642 however, standards were rudimentary at best (Beale, 2012). The beginning of the 1900s saw a move to standardize the admissions process with the development of a College Entrance Examination Board (Romero da Silva, 2017). The inception of the College Entrance Examination Board brought with it the adoption of several admissions requirements. Applicants were required to have a high school diploma and complete entrance examinations as part of the admissions process. In addition, selective admissions began to be adopted which laid the groundwork for the cultivation of the rigorous admissions process that has been adopted by academic institutions today.

Dental hygiene programs strive to select qualified applicants who are most apt to be successful in the program. In an attempt to select the most suitable and competent applicants, rigorous selection processes are in place that can include any number of selection criteria such as academic measures (overall GPA, ACT, SAT, prerequisite course scores, high school math and science scores), shadowing a dental hygienist for a predetermined amount of time and journaling about the experience, a written essay, previous dental experience, applicant interviews, and DEs (See Figure 1). Currently, however, there are no standardized admissions criteria used across all accredited dental hygiene programs (ADHA, 2014, p. 5); according to the ADHA, as cited in Moore et al. (2016), preadmission criteria vary from institution to institution (p. 380). The adoption of admission criteria in dental hygiene programs is a personal institutional and program decision that is made to select student applicants who will be most successful in completing the program (Moore et al, 2016, pp. 379-380).

Dental Hygiene Admission criteria	Source
Standardized testing (ACT, SAT)	Chow & Milos, 2019; Moore et al., 2016; Sanderson & Lorentzen, 2015
Overall GPA (high school and/or college)	Chow & Milos, 2019; Moore et al., 2016
Math and Science grades	Chow & Milos, 2019; Moore et al., 2016
Prerequisite course grades	Chow & Milos, 2019; Moore et al., 2016
Multiple Mini Interviews	Chow & Milos, 2019
Job Shadowing	Moore et al., 2016
Dental Hygiene Aptitude Test	Moore et al., 2016; Sanderson & Lorentzen, 2015
Manual Dexterity Testing	Moore et al., 2016; Sanderson & Lorentzen, 2015
Letters of recommendation	Moore et al., 2016
Previous dental experience	Sanderson & Lorentzen, 2015
Personal Essay	Sanderson & Lorentzen, 2015

Figure 1. Representation of preadmission criteria used by dental hygiene programs in the literature.

Academic success leads to high pass rates on national and regional clinical board examinations while aiding in increased retention and low attrition rates. Academic aptitude and proficiency in dexterous abilities are essential foundational skills required of the dental hygienist. All too often, students accepted into dental hygiene programs excel academically in didactic courses but struggle in pre-clinical courses because of an inability to translate theory to practical skill (Taft et al., 2015, p. 115). If foundational skills are lacking, student success and program

completion can be compromised causing negative repercussions on the student, program, and institution.

Dexterity, psychomotor, gross, and fine motor skills are vital components of the role of the dental hygienist needed for patient treatment and care, however, only 3% of accredited dental hygiene programs in the U.S. use a type of DE as part of the admissions process (Sullivan et al., 2014, p. 247). Upwards of 70% of accredited dental hygiene programs use overall college or science GPA as preadmission criteria (ADHA, 2014); however, academic scores are not always a valid predictor of clinical aptitude and performance (Rudy et al., 2017, p. 24). Recognizing the fine motor dexterity skill of a dental or dental hygiene applicant prior to admission can be beneficial in the applicant selection process (ADA, 2019b, p. 7). The literature has shown DEs to be an effective means to identify weak students who may have difficulty keeping up with the clinical demands of the curricula (Schwibbe et al., 2016; Segura et al., 2018; Sullivan et al., 2014). Students who are found to have low dexterous skills can be easily identified by faculty. A determination can then be made as to which students may need clinical remediation skills early in the program or which may not be a good fit for the rigorous clinical demands of the dental hygiene program.

There is a gap in the literature regarding DEs as a preadmission criterion in dental hygiene programs and how their use, or lack of, may impact individual programs and institutions. Much of the research on DEs as a preadmission criterion focuses on their use and benefit in dental schools. This study sought to understand how DEs are being used as a preadmission criterion in dental hygiene programs and the perception of program directors regarding the reliability and validity of DEs as a preadmission tool. In addition, this study focused on factors that impact the feasibility of use with implementing DEs into the dental

hygiene preadmission process. Through a qualitative design using in-depth interviews, the information gathered from this study may serve several benefits in dental hygiene education. Advantages may include new knowledge surrounding the following concepts of manual dexterity and the dental hygiene admission process:

- Identifying how DEs are currently being used.
- Identifying perceptions regarding the feasibility of use.
- Discovering barriers or challenges associated with the use of DEs.
- Offering direction and guidance to other dental hygiene programs regarding implementing DEs as a preadmission criterion.
- Identifying program advantages and/or disadvantages associated with the use and implementation of DEs.

Organization of the Chapter

The organization of this chapter continues with a review of the conceptual frameworks used to connect the literature to the research questions. Phenomenology and Skill Acquisition Theory will be discussed as well as their relationship to DEs as a criterion for preadmissions into a dental hygiene program. Next is an extensive review of the literature as it pertains to DEs and their existing role in the preadmission process of dental, dental hygiene, and other healthcare disciplines. A review of methodological issues will be discussed followed by a synthesis of research findings. Lastly, a critique of the previous research is followed by a summation of the main points in the chapter.

Conceptual Framework

The primary concept of dexterity centers around the ability of an individual to manipulate objects with the use of his or her hands with purpose and skill (Gonzales-Sanchez, 2016, p. 10). Nikolai Bernstein, a neurophysiologist, is a seminal leader in dexterity after his published work in 1943 titled, *On Dexterity and its Development*. Bernstein, as cited in Gonzales-Sanchez (2016), broadly defines dexterity as, “the ability to find a motor solution for an external situation, that is, to adequately solve an emerging motor problem accurately, quickly, rationally, and resourcefully” (p. 10). Bernstein explains dexterity is not based solely on skill; rather dexterity is a multidimensional process involving an individual’s ability, level of cognition or cognitive processes, interaction with the nervous system and the ability of each to work together to perform a dexterous task (as cited in Gonzales-Sanchez, 2016, p. 10). Coordination of several body systems such as the muscular, skeletal, neurological, and special senses of the eyes, must occur for harmonious movements to take place (Makofske & Power, 2017, p. 1). Dexterity develops over time with the most basic skills learned in the formative years of development. These skills may include but are not limited to utilizing the pincher reflex to pick up small objects, stacking blocks, grasping a pencil, writing with a pen, dressing oneself, tying shoelaces, and brushing one’s hair to name a few (Makofske & Power, 2017, p. 1).

Skill Acquisition Theory

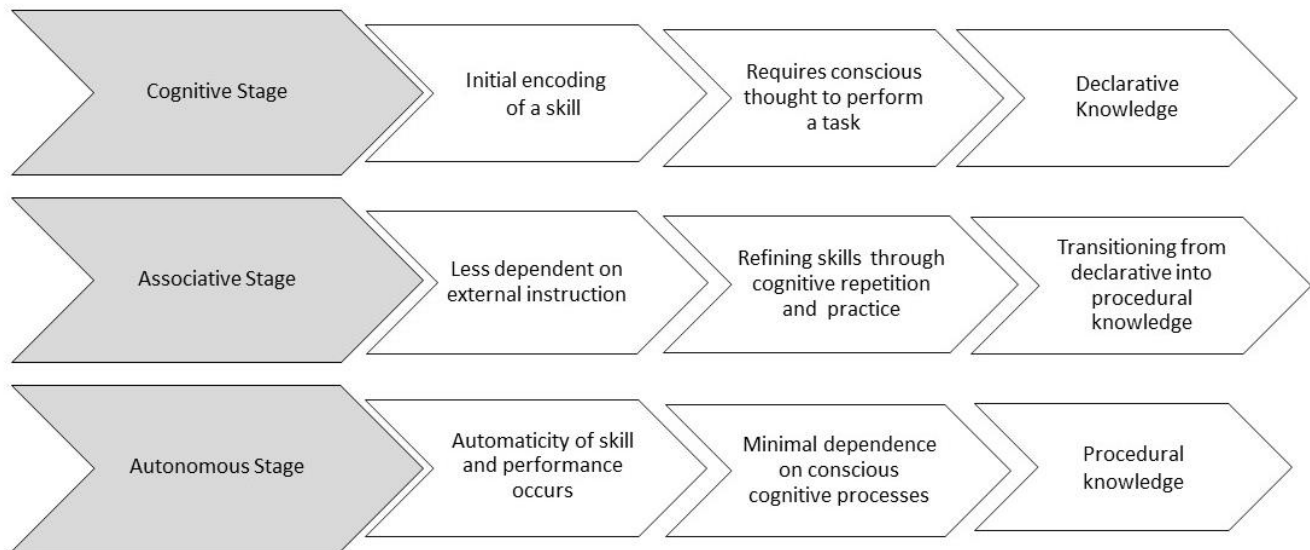
Skill acquisition theory is, “a general learning theory ranging from cognitive to psychomotor skills” (Taie, 2014, p. 1971). Skill acquisition can also be termed as motor learning and control.

Skill acquisition is an umbrella term specific to the knowledge of and knowledge about what behavioral and neurological variables influence central nervous system adaptation in response to the learning or re-learning of a motor skill. In simplified terms, skill acquisition refers to voluntary control over movements of joints and body segments in an effort to solve a motor skill problem and achieve a task goal. (Singh, 2018, para. 4)

Principle of the Skill Acquisition Theory. The basic premise of the Skill Acquisition Theory surrounds the acquisition of skills as a form of knowledge attainment where skilled behaviors are learned, practiced, and eventually become automatic. Fitts and Posner proposed a three-stage model of skill acquisition in 1967. The first stage is called the cognitive stage in which the learner initially encodes the skill in a form to be able to recall it, perform the desired behavior or skill and include errors in the process. The second stage is called the associative stage. Learners depend less on outside instruction and become more adept at performing a task with fewer errors through skill practice and the refinement of fundamentals. The third and final stage is called the autonomous stage. The skill becomes engrained in the learner, automaticity of performance and skill occurs, and minimal conscious effort is required (Kee, 2019, p. 2; Singh, 2018). This final stage involves a “gradual continued improvement in the performance of the skill...and often continue indefinitely” (Anderson, 1982, p.369).

According to Taie (2014), skill development in this theory involves the use of declarative knowledge and segues to procedural knowledge. Declarative knowledge can be described as having a conscious awareness, thinking, and/or recalling the information in the memory to perform tasks or procedures; one must think about the performance of a skill (Taie, 2014). Procedural knowledge involves automaticity with performance becoming an acquired behavior,

without conscious awareness such as turning a doorknob (Taie, 2014). See Figure 2 for an adaptive model of the Skill Acquisition Theory.



*Figure 2. Stages of skill acquisition. Adapted from “The Role of Strategies in Motor Learning,” by J. A. Taylor and R. B. Ivry. (2012), *Annals of the New York Academy of Sciences*, 1251(1), 1–12.*

Dexterity is an Acquired Skill. The Skill Acquisition Theory applies to the research in this study as manual dexterity is an acquired skill. Dexterity can be improved upon to a certain degree based on exposure to different experiences in an individual's lifetime, through guided instruction, through knowledge acquisition, and through repeated skill practice. All individuals will have different and unique experiences with the environment from birth to adulthood which yields a multitude of diverse experiences with dexterous tasks. The dexterity of an individual is somewhat dependent upon inherent ability defined as, “a general trait influenced by heredity and learning” (Oermann, 1990, p. 202). Due to the unique lived experiences, environmental exposures and inherent ability of each individual, the level of aptitude of manual dexterity can

vary significantly from person to person especially in the initial stages of learning a new dexterous skill. Developmental, neurological, and other health conditions or impairments may prevent acquired levels of dexterity from being achieved. DEs as part of the preadmission process may help illuminate the level of dexterity of students and/or which of the three stages of skill acquisition the student resides in. Student applicants identified as having low dexterity can receive additional guided learning and skill practice with the goal of a higher level of skill acquisition early on in their academic journey.

Schwibbe et al., (2016) conducted a study using Ackerman's Theory of Skill Acquisition to determine the impact of spatial visualization and manual dexterity on the task performance of dental student applicants. One hundred and twenty-nine ($N = 129$) applicants participated in the examination criteria required for admissions. The criteria included overall GPA, Hamburg Assessment Test for Medicine-Manual Dexterity (HAM-Man), science course knowledge and two exams that evaluated manual and spatial ability. Thirty-eight ($n = 38$) of admitted students took part in the first clinical technique course with 31 participating in the successive clinical technique course. Three independent variables were evaluated: high school GPA, spatial ability via the Technical Aptitude of the Leistungspruefsystem and manual ability via the HAM-Man. Results revealed manual and spatial ability show predictability of future performance hence, the abilities of novice dental students can strongly predict their performance and therefore, should be included as preadmission criteria for the selection process for student applicants (p. 852). As both manual dexterity and spatial ability are important elements required for successful completion in a dental or dental hygiene program due to the proficiency required for transferring knowledge to clinical skills, the aptitude of applicants in both areas should be evaluated in the preadmissions process.

Phenomenology

Foundation of phenomenology. Phenomenology focuses on the direct investigation of experience, concept, or phenomenon of interest-based on the lived experiences of participants (Biemel & Spielberg, 2019, para. 1). Edmund Husserl, a German philosopher, is the father of phenomenology, however, the concept continued to evolve over time into two main branches: hermeneutic and transcendental phenomenology. This study focused on transcendental phenomenology, which is centered around inner consciousness, one's own experiences, and how those experiences are perceived and viewed by the individual experiencing them (Smith, 2018). Transcendental phenomenology is:

The motif of questioning back to the last source of all achievements of knowledge, of reflection in which the knower reflects on himself and his knowing life, in which all the scientific constructs which have validity for him, occur teleologically, and as permanent acquisitions are kept and become freely available to him. (Husserl as cited in Biemel & Spielberg, 2019, para. 26)

Phenomenological research is used in qualitative studies to understand the experience of a certain concept or phenomenon of interest. The researcher used bracketing which is an attempt to put aside his or her own experiences and/or preconceived notions about the concept or phenomenon to be studied. In-depth interviews were conducted allowing the lived experiences of the participants to be shared. Significant statements are gathered and placed into themes based on similarity. Examining the views of study participants allows the researcher to “make generalizations regarding what it is like to experience a certain phenomenon from the perspective of those that have lived the experience” (Grand Canyon University, 2019, para. 2).

The rationale of phenomenology as a conceptual framework. Phenomenology is the qualitative design for this research study as the purpose is to understand what the experience of program directors are at accredited dental hygiene programs regarding the use of DEs as criteria for preadmission. In-depth interviews were used guided by the research questions discussed in Chapter One. This study was conducted using open-ended questions allowing participants to fully discuss individual lived experiences from a personal point of view. A small sample size was used, and data was collected and analyzed identifying textural themes. A phenomenological approach was appropriate for this study as the author sought to understand how a specific group of individuals experienced a certain concept or phenomenon, DEs as a preadmission requirement in dental hygiene programs.

Review of Research Literature and Methodological Literature

Existing Admissions Criteria

The CODA has developed standards that each dental hygiene institutional program must adhere to for accreditation. The standards include four broad sections: institutional effectiveness, the educational program design administration, faculty and staff, and educational support services (CODA, 2017, p. 3). Admissions is a subcategory within the broad category of *educational program design*. According to CODA (2017) standard 2.3:

(The) admission of students must be based on specific written criteria, procedures, and policies. Previous academic performance and/or performance on standardized national tests of scholastic aptitude or other predictors of scholastic aptitude and ability must be utilized as criteria in selecting students who have the potential for successfully completing the program. (p. 18)

Due to the standard's strong focus and stance on academic performance, most dental hygiene programs primarily use academic measures as an admission criterion. Moore et al., (2016) conducted a study of national admissions used in dental hygiene programs. Ninety-nine (N = 99) accredited dental hygiene programs were surveyed. The study data indicated 90% of dental hygiene programs utilize science course grades as selective admissions criteria with 75% using college GPA, 41% using standardized testing (i.e. SAT, ACT) and 35% using math course grades (p. 384). Similarly, the ADHA (2014) reports 70% of all dental hygiene programs use college science GPA and overall college GPA as admission criteria (p. 9). Academic criteria can include minimum average requirements in high school courses in mathematics, sciences and English, college entrance examination scores and prerequisite courses (ADHA, 2014, p. 8).

Dexterity Examinations as Criteria for Admissions in the Health Professions

Dentistry. Dentistry is a profession that utilizes DEs as part of the admission process. The professions of dental hygiene and dentistry both require psychomotor skills in order to combine the harmonious use of sensorial information with a muscular response along with the synchronization of hand-eye muscle coordination and movement to manipulate a bevy of dental instruments and tools (Segura et al., 2018, p. 1098). Fine motor skills are needed to manipulate dental instruments in small working spaces with precision, efficiency, safety, and care.

Dental schools use the Dental Aptitude Test (DAT) as part of the admission process with the objective of assisting dental schools in selecting applicants with the best qualifications most apt for success in a dental program (ADA, 2019c; Segura et al, 2018, p. 1098). The DAT consists of four main components: a survey of natural sciences, a Perceptual Ability Test (PAT), a reading comprehension test and a quantitative reasoning test (ADA, 2019b, p. 13). The PAT is

composed of six subsets which include apertures, view recognition, angle discrimination, paper folding/hole punching, cube counting, and 3D form development (ADA, 2019b, p. 7). These subsets are all associated with identifying an individual's fine motor dexterity skill and ability.

In addition to the DAT, dental programs may include a DE as part of the admissions process to ensure applicants selected for admission are those who are most likely to succeed. Manual dexterity tests may include, but are not limited to: O'Conner Tweezer Dexterity Test, Grooved Pegboard Test (GPT), Purdue Pegboard Test (PPT), Crawford Small Parts Dexterity Test (CSPDT), Box and Block Test (BBT), and the Minnesota Manual Dexterity Test (Causby, Reed, McDonnell & Hillier, 2014, p. 768; Neves & Garcia, 2018, p. 2). According to Lugassi et al. (2018), it is essential to recognize students who have been accepted into dental programs and are identified as weak regarding fine motor skills. Doing so allows additional teaching, training, and guidance early on in their academic journey increasing chances for success and program completion (p. 11).

Segura et al. (2018) designed a psychomotor skills examination called the DePS (Dental Psychomotor Skills Test) as an instrument to identify and assess fine motor skills of dental students which are vital to clinical dental education and practice. Four cohorts consisting of 237 first-year dental students and 16 faculty instructors at the Universidad Austral de Chile dental school were evaluated using the DePS to determine the ability of this instrument to assess the psychomotor abilities of novice dental students. The DePS was assessed for validity by a focus group of healthcare professionals and consisted of three dimensions of assessment:

- ***Instructions Follow-Up*** – “The ability to understand, process and follow indications delivered by groups and individually, demonstrated in manual work”

(Segura et al., 2018, p. 1099). This assessment involved students bending wire with tweezers based on verbal and written instruction.

- **Accuracy**- Evaluating pulse control and motor precision with the use of two areas: Beads pinch whereby students place beads in holes using tweezers in a two-minute time period and through an acid etching simulation whereby students traces paint in an acid etch syringe device over a lined image to assess homogenous of line thickness, accuracy on existing lines, etc. (Segura et al., 2018, pp. 1099-1100).
- **Indirect vision** - “The ability to carry out meticulous performance with specular vision in a reduced and delimited space” (Segura et al., 2018, p. 1100). Students were instructed to use a large dental mirror with topside obstruction of view to manipulate a pencil in a labyrinth while filling geometric shapes.

Results of the study revealed that faculty had significantly higher scores when compared to the students especially as it pertained to the dimension of indirect vision. This supports the ability of the DePS to identify individuals with high and low levels of psychomotor skill. Recognizing the fine motor dexterity of an applicant prior to admission can be beneficial in the dental applicant selection process (ADA, 2019b, p. 7). In addition, DEs like the DePS can be beneficial in appraising students’ psychomotor abilities and identifying those in need of remediation and careful monitoring of clinical skills. “The DePS test should be used to identify students who need additional training, monitoring, and feedback, allowing the curriculum and faculty to...detect weak points that may require improvement and adapt instruction to the individual needs of the students” (Segura et al., 2018, pp.1103-1104).

Cleghorn et al. (2018) performed a study of dental students (N = 123) at Dalhousie University over a six-year period to determine the relationship between Manual Dexterity Test (MDT) scores and psychomotor skill (PM) scores received in preclinical courses. Course coordinators (n = 3) placed students into MDT categories according to their psychomotor skills performance ability with PM1 (0-10) indicating weak skills, PM2 (11-20) average skills, and PM3 (21-30) exceptional skills (Cleghorn et al., 2018, p. 879). The strongest association observed between MDT scores and clinical skill scores were with the clinic coordinator. The coordinator recognized 83.3% of her students as having weak psychomotor skills. Those same students had MDT scores in the PM1 category indicating weak skills. The results of the study indicate that the MDT had high sensitivity and was able to identify students entering the program with weak psychomotor skills. Results support the use of the MDT as a criterion in the admissions process (Cleghorn et al., 2018, p. 881).

Lugassy et al. (2018) performed a study to assess the manual skills of preclinical dental students and junior dental practitioners (defined as having three to five years of clinical experience in a public health clinic); n = 65 and 30, respectively. All participants were evaluated using the PPT and O'Connor Tweezer Dexterity test over three points in time: preclinic prior to phantom training (manual skills practice on a simulated head), post phantom training and in the middle of the next academic year. Some of the research aims were: (a) to identify whether DEs were sensitive to students' psychomotor skill improvement over the first year and a half of study, (b) to determine whether DEs were able to reflect psychomotor development, and (c) to ascertain whether the Purdue Pegboard Dexterity Test (PPT) and O'Connor Tweezer Dexterity test could predict student success in students' preclinical year (Lugassy et al., 2018, p. 2). Based on data collected from pre-training DE scores, "a logistical regression model predicted student success in

the course with 74% accuracy” (Lugassy et al., 2018, p.10). The study results support the use of DEs during the applicant process as an indicator of preclinical success (Lugassy et al., 2018, p.10). In addition, results revealed a significant improvement in dexterity scores of students post phantom training compared to pre-training indicating a positive transfer of knowledge to skill. The junior dental practitioners did not show significant improvement in scores which could be attributed to already having attained competence of skill.

Kothe, Hissbach, and Hampe (2014) conducted a study to determine if the Hamburg Assessment Test for Medicine- Manual Dexterity or HAM-Man (wire bending test used to assess the manual abilities of applicants) in conjunction with high school GPA was a useful tool in the dental school applicant selection process. Study participants included dental freshmen (N = 146) in three consecutive cohort years. The results showed that using GPA as a preadmission criterion resulted in having a minimal influence on practical laboratory performance (less than one percent in some regression models) while the HAM-Man had a much greater impact on preclinical performance at 20.5 percent. This study supports the use of the HAM-man test as an effective tool in the dental applicant selection process and demonstrates that overall GPA is not always a good predictor of academic success especially as it pertains to hands-on ability. These findings could be because GPA scores primarily focus on cognitive ability while DEs such as the HAM-man are focused on evaluating fine motor skills and dexterity (Kothe et al., 2014, p. 4).

Medicine. Psychomotor skills and manual dexterity are used in many healthcare professions and disciplines such as general and specialty medicine, surgery, nursing, and podiatry (Causby et al., 2014, p. 765). A systematic literature review regarding the use of objective psychomotor tests in health professionals was performed by Causby et al. (2014). The authors found that the PPT, the O’Connor Tweezer Dexterity Test and the GPT are most used in

the healthcare professions (p. 788). González Sánchez (2016) also reported the PPT as one of the top dexterity assessments used in the health professions because of “its reliability and validity as well as its fewer confounding variables, such as age, gender, and handedness” (p. 38).

According to González Sánchez (2016), the PPT has been used for a variety of testing applications in the healthcare field such as occupational therapy, physical therapy, work assessment, and as a screening tool for employment (p. 36). The PPT was originally developed in 1948 with the goal of assessing the manual dexterity and bimanual ability of assembly line workers (González Sánchez, 2016, p. 35). The premise of the test is based on an individual’s ability to place small objects such as pins, washers, and collars into a pegboard containing two parallel vertical lines of holes (25 per row) in a 30 second time-period. The participant must complete four subsets using their dominant hand, nondominant hand and both together using bimanual manipulation (George-Paschall, 2018). Scores are calculated based on the number of correct objects placed in the pegboard within the designated time frame. Currently, there is no single preferred test of choice used in the healthcare professions as the selection of a manual dexterity assessment tool is dependent upon the criteria being evaluated or upon the correlations being made. For example, the MDT is beneficial in identifying students “who will experience difficulty in pre-clinical training” (Neves & Garcia, 2018, p. 3). Similarly, “the Purdue Pegboard Test is useful for analyzing motor coordination and both gross and fine motor skills” (Neves & Garcia, 2018, p. 3). This lack of specificity allows for variation in the selection of manual DEs used across healthcare disciplines.

Hughes, Forest, Foiti, and Chao (2014) sought to examine medical students' innate dexterity ability and if previous experience attainment may influence the development of manual dexterity and suturing performance. Third-year medical students (N = 64) participated in the

study. Students completed a 10-question survey regarding the following variables: demographics, past job experience, hobbies/experiences that used manual motor skill, previous manual skill practice, and self-assessment of their existing level of dexterity. A manual DE was completed by all participants using the PPT along with a suturing skill assessment. Of the variables examined, only innate manual dexterity was significantly correlated with high suture skill scores signifying a relationship between inherent dexterous ability and clinical performance. High PPT scores were positively associated with high suture close scores (Hughes et al., 2014, p. 302). Students who possess innate ability are those who can easily build upon an existing foundational skill and typically segue into a surgical or procedural-based specialty career (Hughes et al., 2014, p. 305). The study of Hughes et al. (2014) demonstrated that PPT was a strong predictor of manual dexterity ability which has implications for use in the medical field. According to Hughes et al. (2014) implementation of a DE may allow for a curriculum component to be developed that focuses on the improvement of manual skill (p. 305). Identifying and strengthening students with low dexterity ability prior to residency may yield a more skilled, competent, and prepared student while also reducing the incidence of attrition from surgical training rotations for failure to perform manual tasks safely and efficiently (Hughes et al., 2014, p. 305).

A retrospective study by Dabaliz et al. (2017) examined the predictive validity of preadmission variables on medical students' performance using cumulative GPA (cGPA) and the progress test (PT). The PT is, "a longitudinal assessment method used to measure student achievement and progression; focuses on functional knowledge or knowledge that comes from repetition" (Dabaliz et al., 2017, p. 409). Demographic data and preadmission variable data, inclusive of cumulative GPA (cGPA), the National Achievement Test score (NAT) and General

Aptitude Test score (GAT), were collected from 737 students in preclinical and clinical years.

The research findings of Dabaliz et al. (2017) were as follows:

- Cumulative high school GPA did not predict cGPA in preclinic or clinical courses.
- The GAT is a negative predictor of cGPA in preclinic or clinical courses.
- The NAT was not predictive of performance in clinical years but showed some predictability in preclinical years.

Dabaliz et al. (2017) recommend the development of more sensitive preadmission assessment variables that can predict student performance in preclinic and clinical years (p. 412). Research has shown that manual DEs such as the PPT and HAM Man are strong predictors of the manual abilities and preclinical skills of individual students. This may explain the frequent use of fine motor testing examinations in the healthcare professions (Gonzales Sanchez, 2016; Hughes et al, 2014; Lugassy et al. 2018). This study supports the need for preadmission criteria that can aid in forecasting students' clinical performance.

Dexterity Examinations as a Predictor of Clinical Performance

Sullivan et al. (2014) conducted a study where hands-on interviews were performed on nine consecutive dental hygiene student cohorts (N = 174). The hands-on interviews consisted of three manual dexterity tests: the O'Connor Tweezer Dexterity Test, the GPT, and the Symbol Digit Modalities Test. Results revealed that pre-clinic and graduation scores showed little to no improvement in the hands-on ability of students as they progressed throughout the dental hygiene program. Results demonstrated that individuals possess innate ability when it comes to manual dexterity and offered some justification for selecting applicants with improved dexterity prior to the start of a dental hygiene program (Sullivan et al., 2014, p. 250). In addition, Sullivan

et al. (2014) concluded that fine motor skills and/or dexterity can be evaluated successfully via the O'Connor Tweezer Dexterity Test and the Symbol Digit Modalities Test as both were significant predictors of clinical success (p. 250).

Holmes et al., as cited in Sanderson and Lorentzen (2015) analyzed dental student scores on the perceptual abilities portion (PAT) of the DAT (which is aimed at identifying an individual's fine motor dexterity skill and ability), and how those scores correlated to passing scores on the clinical board examination. Data revealed that students who passed the clinical board examination had a higher PAT score when compared to students who failed the clinical boards. Students who failed the clinical board examination were found to have markedly lower PAT scores (p. 102). The findings support the concept of inherent dexterous ability and the potential for inclusion in the preadmission process of dental hygiene programs.

Dexterity Examinations as a Predictor of Academic Success

Chow and Milos (2019) investigated whether student prerequisite grades and interview scores were a valid predictor of academic success in a dental hygiene program at the University of Alberta, Canada. For the purpose of this research study, the author focused on the results of academic grades and not applicant interviews. The academic records of students who attended the University between 2004 and 2013 were examined (N = 313). Data analysis revealed prerequisite course grades were weak predictors of the academic success of students (Chow & Milos, 2019, p. 185). Based on the results of the study, careful consideration should be given to which preadmission criteria will offer the most predictability regarding student success and completion of a dental hygiene program.

All applicants wishing to enter the profession of dental hygiene must successfully pass the NBDHE to obtain licensure. The NBDHE is a comprehensive examination with three fundamental requirements: educational as well as a written and clinical examination requirement (Joint Commission on National Dental Examinations, 2019, p. 4). Sanderson and Lorentzen (2015) conducted a study of dental hygiene programs (N = 133) in the U.S. to explore the impact of preadmission criteria as an indicator of pass rates on the NBDHE. Written national examination pass rates (N = 133) and clinical (n = 131) pass rate data was collected. Three independent categories of variables were explored: GPA (overall college, high school, and science GPA), standardized testing (ACT score) and non-cognitive variables (i.e. DEs). GPA admissions and the use of standardized tests (ACT) were not identified as statistically significant variables to assess pass rates on either portion of the NDHBE. These results support the need for preadmission criteria that can assess psychomotor abilities in addition to the cognitive abilities of potential applicants as both are essential elements in the dental hygiene process of care and treatment.

Rudy et al. (2017) conducted a retrospective study to evaluate the admissions criteria that influence dental hygiene students' performance on the National Board Dental Hygiene Examination (NBDHE). Application forms and education records of 121 students were collected from 2008-2011 at the University of Louisville School of Dentistry dental hygiene program. Predictor variables included the continuous covariates of age, overall GPA, Science GPA, curriculum GPA (all program pre-requisite course requirements) and ACT scores along with several categorical covariates. Results showed that none of the predictor variables assessed were significant in predicting clinical board examination scores suggesting that current variables used in the admissions process are not indicators of a students' ability to pass the clinical board

examination (p. 27). In addition, when predictor variables were examined in relation to the written NBDHE scores, a significant correlation was observed with ACT scores indicating students with higher ACT scores had an increased likelihood of performing well on the NBDHE. This study supports the use of ACT scores as a predictor of success on the written portion of the NBDHE and highlights the need to implement a preadmission criterion that can forecast students' clinical performance.

Student Retention

Student retention is a primary focus of all academic institutions. According to the National Center for Education Statistics (NCES [2019]), the retention rates of first-time, full-time degree-seeking students at two-year public institutions and private institutions during the 2016 academic year were 62% and 67% respectively. At four-year institutions, the mean retention rate in 2016 for private and public colleges was 54% and 81% respectively (NCES, 2019). According to the NCES (2019), upwards of 46% of first-time, full-time degree-seeking college students drop out.

CODA standards. Dental hygiene programs use preadmission criteria to aid in selecting students who will be most successful in the program and ensure student retention (Moore et al., 2016, p. 380). Dental hygiene programs are accredited by CODA and to maintain accreditation, certain standards must be adhered to. Adherence to the outlined standards is reviewed methodically and comprehensively by CODA during site visits of accredited dental hygiene academic institutions every seven years. Standard 2-3 within the subheading of admissions reads as follows:

(The) admissions of students must be based on specific written criteria, procedures, and policies. Previous academic performance and/or performance on standardized national tests of scholastic aptitude or other predictors of scholastic aptitude and ability must be utilized as criteria in selecting students who have the potential for successfully completing the program. Applicants must be informed of the criteria and procedures for selection, goals of the program, curricular content, course transferability and the scope of practice of and employment opportunities for dental hygienists. (CODA, 2017, p. 20)

Intent: The dental hygiene education curriculum is a postsecondary science-oriented program that is rigorous and intensive. Because enrollment is limited by facility capacity, special program admissions criteria and procedures are necessary to ensure that students are selected who have the potential for successfully completing the program. The program administrator and faculty, in cooperation with appropriate institutional personnel, should establish admissions procedures that are nondiscriminatory and ensure the quality of the program. (CODA, 2017, p. 20)

According to CODA (2017), examples must be provided as evidence to demonstrate compliance. Examples of evidence can include the following:

Admissions management policies and procedures, established ranking procedures or criteria for selection, the periodic analysis supporting the validity of established admission criteria and procedures, results from institutional research used in interpreting admissions data and criteria and/or correlating data with student performance, graduation rates, analysis of attrition and employment rates. (CODA, 2017, pp. 20-21)

Due to the admissions standards mandated by CODA, program completion rates, success on state and national board exams, and student retention and attrition rates are of vital importance to dental hygiene programs because all are used as evaluative tools to assess individual program effectiveness for accreditation (Sanderson, 2014, p. 235). Admission procedures used must be able to identify applicants who are most likely to complete the dental hygiene program successfully. Attrition rates can negatively affect both the institution and students matriculated into the program. At some institutions, program funding and evaluation are based on student retention and program completion causing loss of financial support for the program and reduced status and/or reputation of program effectiveness (Moore et al., 2016, p. 379). For the student who has committed the time and money to a dental hygiene program, the impact of program dismissal or failure to complete the program can be distressing. In addition, due to a limited number of applicants accepted into programs each year, students who fail to complete preclinical courses take away a coveted position from another potentially successful applicant.

Student retention in dental hygiene education programs. A 2017/2018 *Survey of Allied Dental Education - Report 1 – Dental Hygiene Education Programs* collected data on all accredited dental hygiene programs within the U.S. The outcomes assessment for students enrolled in a dental hygiene program in 2016 indicated that 8,157 students were enrolled in an accredited dental hygiene program with 7,103 successfully completing the program yielding an 87.1% retention rate and a 12.9% attrition rate (HPI & CODA, 2019).

Whisenhunt, as cited in Evans et al. (2011), discussed during an interview, the study findings of attrition rates of a single dental hygiene program over a three-year period after faculty reported students struggling with preclinical competencies (p. 7). The results of the

three-year study revealed 8% of students were dismissed during the first year of the program due to inadequate clinical skills followed by 33.3% the second year and 25% the third year. High attrition rates were directly correlated to students who were unable to perform clinically or had weak fine motor skills.

Dexterity examinations and student retention. Moore et al. (2016) conducted a study of directors of accredited dental hygiene programs (N = 99) to determine the impact of selective versus nonselective admissions protocol on attrition rates. Selective admissions were defined as selecting a student applicant based on academic and character-related criteria while nonselective admissions were defined as selecting a student applicant without review of previous academic experiences or successes (Moore et al., 2016, p. 381). Data revealed 88% of programs utilize selective admissions protocol, while 12% report using nonselective admissions protocol. Science scores, college GPA, standardized examinations and math course scores were listed as the most common selective admissions criteria used by accredited dental hygiene programs; 90%, 75%, 41%, and 35% respectively. Factors in student attrition were also assessed with the most common factors of attrition being failure to meet academic standards, personal issues, clinical skills, and preclinical course failures. Results also showed no statistical significance in attrition rates when comparing selective to nonselective admissions criteria. Preclinical course failures and an inability to meet the clinical demands of the program were listed as the third and fourth most common factors influencing student attrition following a failure to meet academic standards and personal issues. This study supports the need for a preadmission criterion that can assess the manual dexterity required for the clinical rigors and demands of a dental hygiene program.

Similarly, Sanderson (2014) sought to examine preadmission variables that correlate to the retention of dental hygiene students. Directors of accredited dental hygiene programs across the U.S. were surveyed (N = 139). The standardized test variables of overall college and high school GPA were significantly related to program retention. Noncognitive variables such as manual dexterity tests, personality assessments, and spatial ability showed a trend toward reduced retention rates (Sanderson, 2014, p. 238). These findings could be due to the limited number of dental hygiene programs using manual dexterity tests, personality assessments, and spatial ability as noncognitive variables used in the admissions process. According to the results of the Sanderson (2014) study, only 3% of programs used DEs and personality assessments for preadmission criteria, while four percent report using spatial ability examinations. Also, “too small a sample may prevent the findings from being extrapolated” (Faber & Fonesca, 2014, p. 27). With a sample that is too small, the data from one school can have a significant effect on the overall retention statistics of each category.

Review of Methodological Issues

The review of the literature uncovered the use of several study designs and methodologies that address the issue of manual dexterity as a preadmission criterion. The studies reviewed included literature reviews, mixed methodology studies (a combination of quantitative and qualitative), strictly quantitative research, retrospective cohort, longitudinal and experimental studies. Some design examples included descriptive, correlation, experimental and survey research. A review of the research did not uncover any studies of manual DEs as a preadmission criterion that was strictly qualitative in nature indicating a gap in the design framework used in the literature. Each research design contains strengths and weaknesses which will be discussed in this section.

Biases Recognized in the Literature

Weaknesses in study design are usually found in the form of biases. According to Polit and Beck, as cited in Galdas (2017), bias is commonly defined as, “Any influence that provides a distortion in the results of a study” (p. 1). Althubaiti (2016) further expands upon that definition stating, “Bias can be defined as any systematic error in the design, conduct, or analysis of a study” (p. 211).

Self-reporting bias. According to Althubaiti (2016), self-reporting bias can occur when participants are required to self-report data and when:

- Patients tell researchers what they think they want to hear rather than providing truthful responses.
- Patients are asked to recall specific details and recall information over extended periods of time (i.e. did you consume a starch with dinner six weeks ago). Truthfulness is based on the ability of the study participant to recall a past experience.
- Patients may provide untruthful responses when there is a fear that anonymity cannot be guaranteed, and their responses may cause direct negative attention or outcomes to themselves or their families (p. 212).

Self-reporting bias is most common in research designs that require participants to self-report data such as questionnaires, surveys, and interviews as well as observational studies such as comparative and cohort studies (Althubaiti, 2016, p. 212). An example of self-reporting bias is social desirability bias which involves participants telling researchers what they think is true, what they think researchers want to hear, or what they feel is socially acceptable (Mertler, 2016). This is especially true if participants' questions are personal in nature (i.e. drug use) and

anonymity is not guaranteed. Self-reporting bias is a concern because of the potential to affect study findings and research conclusions. “Bias can lead to inaccurate estimates of association or over-or underestimation of risk parameters” (Althubaiti, 2016, p. 211).

Sanderson (2014) performed a survey of dental hygiene department chairs via an online survey in an effort to identify preadmissions criteria related to student retention. Academic institutions strive for high retention rates and low attrition rates, therefore, answering a survey indicating retention rates of a specific program are low may cause a negative community perception, potentially affecting funding, academic ranking, and reputation. In this study, social desirability bias may have contributed to the high retention rates reported ($M = 91$) in the study of dental hygiene programs.

Moore et al. (2016) conducted a study of dental hygiene program directors using surveys comparing attrition rates using selective and nonselective admissions processes. Factors in student attrition were also assessed with the most common factors of attrition being failure to meet academic standards, personal issues, clinical skills, and preclinical course failures. In this study, social desirability bias is possible as dental hygiene program directors were asked to disclose delicate program statistics. Sharing program attrition rates and the reasons associated with attrition may have caused an underestimation of rates minimizing potential associations reported in the study.

Recall bias. An additional type of self-reporting bias is recall bias. Recall bias occurs when study participants are made to remember or recall a previous event, or events, that are remembered incorrectly resulting in recall error (Althubaiti, 2016, p. 213). Hughes et al. (2014) conducted a study of medical students' innate dexterous aptitude to determine if previous

dexterity experience attainment impacts the development of suturing performance and students' innate manual dexterity ability. Part of the data collected came from a 10-question survey that asked study participants to recall previous life experiences that required the use of dexterity or fine-motor skills. Recalling experiences that have occurred days, years, or decades ago can be difficult to recollect with accuracy. As such, participant responses are subject to recall bias as replies may be inaccurate.

Questionnaires, surveys, and interviews are all beneficial in obtaining the views and perspectives of study participants, however, care should be taken to attempt to minimize social desirability bias. This can be achieved by validating the survey instrument, such as selecting one that has been used on a population with like characteristics. In addition, measurement scales such as the Marlowe-Crowne Social Desirability Scale can be used to assess the social desirability of the information being collected (Althubaiti, 2016, p. 212). To minimize recall bias the researcher establishes a shortened time interval to recall information from (i.e. the previous three months) or encourage the use of a diary if a longitudinal study over a prolonged period of time (Althubaiti, 2016, p. 213).

Sample Size and Characteristics

Sample size. The sample size of a study is a factor that can influence the outcomes of the research and potentially compromise conclusions and relationships deduced from a study. To determine the appropriate sample size of a study, a sample size calculation must be employed. The type of sample calculation used depends on many factors: the variable(s) being studied, what is being measured, type of statistical analysis being used, level of significance, the margin of error, etc. A study with a sample size that is too small may prevent findings from being

discovered assuming a false premise to be true (Faber & Fonesca, 2014, p. 28). A sample size that is too large may inflate findings indicating clinical significance when there is none (Faber & Fonesca, 2014, p. 27).

Sanderson (2014) sought to examine preadmission variables that relate to the retention of dental hygiene students. Directors of accredited dental hygiene programs were surveyed to assess the impact of cognitive and noncognitive variables on student retention. While noncognitive variables such as manual DEs, personality assessments, and spatial ability (3%, 3%, and 4% respectively) showed a trend toward reduced retention rates, this trend could be the result of so few dental hygiene programs reporting the use of these tools in the admission process (Sanderson, 2014, p. 238). Factoring a small sample size into the noncognitive variable data could inhibit the discovery of statistical relationships or correlations between variables. To alleviate sample bias, it is imperative to run sample size calculations as not doing so can compromise the study objective(s), results, validity, time, money, and ethics of research participants (Faber & Fonesca, 2014, pp. 28-29).

Sample characteristics. The group characteristics of survey participants are also a factor that must be considered when reviewing the literature. Kothe et al., (2014), Lugassy et al., (2018), Cleghorn et al., (2018), Schwibbe et al., (2016), and Segura et al., (2018) all performed studies on the impact of manual DEs and psychomotor testing on dental students which included academic institutions from Canada, Chile, Israel, and Germany. While the manual dexterity skills needed for dentists is analogous to that of dental hygienists, the program curricula and competencies are unique to each field. In addition, training and requirements are different outside of the U.S. The sample characteristics of participants (dental student applicants/students) and the research studies taking place in other countries may prevent generalizability of study

results to the profession of dental hygiene within the U.S. In a similar manner, Causby et al., (2014), Dabaliz et al., (2017), and Hughes et al., (2014), performed studies that focused on manual dexterity and the use of psychomotor tests in the health professions (i.e. medical students). As these studies were not performed within the profession of dental hygiene, the ability to generalize the results can be viewed as uncertain and potentially weak.

Several studies looked at improving the manual dexterity of dental hygiene and dental students via a program-specific manual skills program. Taft et al. (2015) conducted a longitudinal quantitative research panel study of dental hygiene students (N = 20) to determine if hand function testing pre and post a six-week therapeutic hand exercise program would show a positive relationship with improved dexterity, manipulation of dental instruments, and student success throughout the program. The results of the Taft (2015) study indicated hand function in 9 out of 11 hand function categories significantly improved after the six-week program implementation (p. 119). Similarly, Evans et al. (2011) performed a study to determine the impact of implementing a manual dexterity program on the preclinical performance of dental hygiene students (N = 14). Students participated in a pre-test, six-week program intervention, and a post-test. After a six-week period, students showed improved grip strength, hand-eye coordination, and improved scores on the Crawford Small Parts Manual Dexterity Test (p. 13). While the studies showed positive results on the abilities and skills of dental hygiene students when a manual dexterity program was employed, research was conducted on participants at only one institution in both studies. To increase validity and reliability, the manual dexterity programs used should be replicated at other dental hygiene programs where additional data can be collected and analyzed further supporting the research findings.

Synthesis of Research Findings

Innate Ability of Dexterity

After reviewing the literature several themes emerged regarding manual dexterity. Based on the Skill Acquisition Theory and studies reviewed in the literature, manual dexterity appears to be an inherent component within each individual (Hughes et al., 2014). Innate dexterous ability is acquired through previous individual experiences during life and may explain why some students enter dental or dental hygiene programs with a higher level of dexterity than others. Innate dexterity is an important element when discussing the manual dexterity of potential dental hygiene applicants as testing for dexterous skill can offer insights as to the potential success of future and novice students. Identifying weak dexterous ability allows faculty to make determinations about the future of the individual such as whether skills are not strong enough to be successful for the rigors of a dental hygiene program or if the student will need to be carefully monitored and participate in skill remediation to improve and develop fine motor skills.

Manual Dexterity Programs

Manual dexterity has been evaluated via DEs to measure innate dexterous ability (Causby et al, 2004, p. 766) and was found to be valuable as an evaluative tool to assess the clinical aptitude of applicants (Cleghorn et al, 2018; Kothe et al, 2014; Lugassy et al., 2018; Segura et al., 2018, and Sullivan et al., 2014). Evans et al., (2011), Segura et al., (2018), and Taft et al., (2015) all performed studies pre and post-implementation of a manual dexterity program to determine the impact on hand function, hands-on ability, and manual dexterity post-program implementation. All three studies showed improvement in hand function and supported the use of manual dexterity programs as a tool to improve the fine motor skills of students.

Admissions Criteria

Admissions into dental and dental hygiene programs are primarily based on academic and cognitive factors (ADHA, 2014, p. 8; Lugassy et al., 2018, p. 2). Cognitive variables used for admission criteria, such as those focused solely on academics (overall college and/or high school GPA, prerequisite course scores, SAT, ACT, etc.), lack predictability in forecasting an applicant's clinical success in a dental hygiene program (Dabaliz et al., 2017; Lugassy et al., 2018; Rudy et al., 2017). Academic scores, while important, have failed to show merit as a reliable and valid predictor of an applicant's ability to succeed clinically or as a means to predict clinical performance (Dabaliz et al., 2017; Lugassy et al., 2018; Rudy et al., 2017). "College and science GPAs do not necessarily indicate dental student success in terms of clinical performance on regional examinations" (Rudy et al, 2017, p. 24). This is due to several factors surrounding reliability and validity. Each academic institution contains variations in grading as some instructors curve examination grades and cumulative course scores (Dabaliz et al., 2017, p. 409). Inconsistency in grading fosters the potential of true academic scores to be skewed. In addition, standardized tests such as the SAT and ACT, as well as cumulative GPA scores of both high school and college, primarily assess the cognitive abilities of students and not clinical abilities that require fine motor skills.

Manual Dexterity Examinations in Dental Hygiene

Lastly, manual dexterity and psychomotor examinations are seldom used as a preadmission criterion in dental hygiene programs. In a 2015 study exploring preadmission criteria as predictors for pass rates on dental hygiene licensure examinations, Sanderson and Lorentzen found that only two percent of participating accredited dental hygiene programs used

manual DEs as part of the criteria used in the admission process which is similar to the findings of the ADA in which 3% of the 323 accredited dental hygiene programs reported as using a type of manual DE as part of the admissions process. According to CODA (2017), the admission of dental hygiene students must use criteria that assess scholastic aptitude and have good predictability in identifying students who have the greatest potential for successful program completion (p. 18). This statement supports the use of admission criteria that can identify the cognitive and clinical aptitude of students.

Critique of Previous Research

Lack of Qualitative Studies

In the review of the literature, there is a lack of qualitative studies examining the thoughts, attitudes, and perceptions of program directors of dental hygiene programs regarding the use of manual DEs as a preadmission criterion. The research designs of the studies reviewed in the literature are primarily quantitative and mixed methodology in nature. Quantitative studies gathered facts and empirical data about the use of DEs but did not uncover a deeper understanding of their specific use as a preadmission criterion.

Study Setting

Some of the studies reviewed in the literature took place both outside of the U.S. (geographic setting) and in dental school settings. Dentistry and dental hygiene are similar in nature due to the manual dexterity needed to manipulate dental instruments. However, they differ in education and program requirements. Similarly, dental and dental hygiene programs outside of the U.S. may be similar in basic concepts however instruction, accreditation, competencies, educational and admission requirements may vary.

Segura et al. (2018) performed a pilot study of dental students in Valdivia, Chile to identify the ability of the DePS as an instrument to identify and assess fine motor skills of first-year dental students (N = 237). Implementation of the DePS was successful as a valid instrument to assess the psychomotor skills of students and identify those as weak and in need of additional training and skill acquisition. Similarly, Schwibbe et al. (2016) conducted a longitudinal study of dental school applicants (N = 129) at Hamburg Dental School in Germany to determine if existing manual dexterity would impact skill acquisition in preclinical dental courses. Manual dexterity was evaluated using the HAM-Man wire bending test. The results of the study suggest spatial and manual ability have high predictability of clinical performance and both should be assessed in the dental admission process (pp. 841,852). In a similar manner, Kothe et al, (2014) performed a study in Hamburg, Germany to determine if the HAM-Man in conjunction with high school GPA was a useful tool in the dental school applicant selection process. Research participants included first-year dental students in three consecutive cohort years, N = 146. The study results demonstrated GPA alone as a preadmission criterion had a minimal influence on practical laboratory performance while the HAM-Man had a more significant impact on preclinical performance (20.5% compared to 1% in some models). Kothe et al. (2014) supports the use of the HAM-man test as an effective tool in the dental applicant selection process and demonstrates that overall GPA is not always a good predictor of academic success especially as it pertains to hands-on ability (p. 4).

The studies by Kothe et al, (2014), Schwibbe et al., (2016), and Segura (2018) were performed at dental schools outside of the U.S. Schooling, competencies, and requirements for licensure vary both outside of the U.S. and in the profession of dentistry, therefore, the results lack generalizability and transferability to dental hygiene programs in the U.S. To improve the

generalizability and transferability of the results, similar studies would need to be performed in dental hygiene programs in the U.S. to increase the reliability and validity of the survey instrument.

Variable Being Studied

The research studies reviewed in the literature evaluating admission criteria variables primarily focused on academic or cognitive abilities and not manual DEs as a preadmission criterion. Chow and Milos (2019) performed a mixed methodology study (retrospective and survey) of dental hygiene students with the aim of assessing if student prerequisite grades demonstrated high predictability of program success and which prerequisite courses faculty at the University of Alberta were perceived as essential. The results of the study indicated prerequisite grades were not a good predictor of student success (Chow & Milos, 2019, p. 183). The results of the study support the use of preadmission criteria that can measure more than just the cognitive skills of applicants and measure all skills needed to complete a dental hygiene program successfully and pass both the clinical and written board examinations needed for licensure to practice dental hygiene.

Moore et al. (2016) performed a quantitative study using an electronic survey of attrition rates in accredited dental hygiene programs (N = 99) using selective and nonselective admissions. “Science course grades (90%) and college GPA (75%) were the most used as admissions criteria” (Moore et al., 2016, p. 381). The main reasons for program attrition were found to be a failure to meet academic standards (61%), personal issues (51%) and preclinical course failures (28%). Even with academic admissions criteria in place, most explanations for

attrition were due to a failure to meet academic standards which would indicate admissions criteria that focus on academics are not the best predictors of student success.

Similarly, O'Rudy et al. (2017) performed a retrospective study of dental hygiene educational records (N = 121) to investigate demographic and admission variables that had high predictability of students' clinical and written board examination scores. However, manual dexterity was not one of the variables assessed in the study. Results of the study revealed no statistical correlation of variables to clinical board examination scores while ACT scores demonstrated a positive relationship to students' written examination scores (O'Rudy et al., 2017, p. 27).

Chapter 2 Summary

Manual DEs have shown to be an effective tool with high predictability to assess the innate dexterous ability and clinical aptitude of dental student applicants and novices (Schwibbe et al., 2016; Segura et al., 2018; Sullivan et al., 2014). In addition, manual DE scores have been positively correlated with improved pre-clinical and clinical scores. Conversely, academic admission criteria have been shown to have low predictability on student success hence, there is a need for the development of more sensitive preadmission assessment variables that can predict student performance in preclinic and clinical years (Dabaliz et al., 2017, p. 412). The review of the literature supports the use of manual DEs as a variable to be assessed in the preadmission process.

There is a gap in the literature regarding DEs as a preadmission criterion in dental hygiene programs and how their use, or lack of, may impact individual programs and institutions. This study broadened the existing yet limited research surrounding DEs as a preadmission criterion in dental hygiene programs by gaining perspective and attitudes of

program directors regarding the predictability, reliability, and validity of DEs as a preadmission tool.

Chapter 3: Methodology

The goal of this study was to gain a deeper understanding of the use of DEs as a preadmission requirement in accredited dental hygiene programs. There is limited research in this area of study as only 3% of all accredited dental hygiene programs report using any type of manual DE as part of their admission process (ADA as cited in Sullivan et al., 2014). The researcher used a qualitative research design using purposeful sampling and one-on-one semi-structured interviews to collect rich data on the perceptions of dental hygiene program directors as it relates to the use and implementation of DEs as a preadmission criterion. The study also collected data on the attitudes of dental hygiene program directors as it pertains to the reliability, validity, and impediments that accompany DE implementation.

The conceptual framework of phenomenology was utilized in this study to measure the perceptions of dental hygiene program directors. Neubauer, Witkip, and Varpio (2019) highlight the importance of phenomenology as a qualitative tool in health professions' education as it allows a unique opportunity to gather a deeper understanding and learning from the lived experiences of other health care professionals. Husserl, who is considered the father of phenomenology, asserts that inquiry into the inner consciousness of individuals (perceptions and experiences) allows the researcher to self-discover the nature and meaning of the phenomena being studied (as cited in Neubauer et al., 2019, p. 92).

The organization of this chapter will begin with a review of the research questions, the purpose and design of the proposed study, the research population and sampling method, and descriptive information about instrumentation and data collection. The chapter will continue with a review of the identification of attributes, data analysis, limitations and delimitations of the research design, validation (credibility and dependability), followed by expected findings. Last,

a review of conflict of interest assessment, the researcher's position, and ethical issues in the proposed study will be discussed followed by a summation of main points in the chapter.

Research Questions

Limited research exists that examines the use of DEs in accredited dental hygiene programs as a preadmission criterion. This study sought to explore the use of DEs as a valid and reliable instrument to assess manual dexterity and fine motor skills, as well as the potential obstacles preventing their use as a preadmission criterion. An inquiry into the perceptions and attitudes of dental hygiene program directors as it relates to DE usage, its validity and reliability as an assessment tool, and obstacles that accompany implementation fostered a deeper awareness and understanding of how DEs are being used in the dental hygiene admission process. Study results expanded the knowledge base of DEs as a preadmission criterion and provide future direction for manual DE use and implementation in dental hygiene education. The following research question and sub-questions helped guide the study:

Research Question

1. How are dexterity examinations used as a criterion for preadmission into accredited dental hygiene programs?

Research Sub Questions

1. What is the perception of program directors regarding the validity and reliability of dexterity examinations as a preadmission requirement?
2. What is the perception of program directors regarding the feasibility and use of implementing dexterity examinations in an accredited dental hygiene program?

Purpose and Design of the Proposed Study

Purpose of the Study

The primary purpose of the study was to identify how DEs are used as preadmission into accredited dental hygiene programs. Additionally, the researcher sought to identify factors that may impede the use of manual DEs as preadmission criteria in dental hygiene programs, as well as determine their practicability of use. It is essential to understand if the utilization of DEs is perceived as a valid and reliable tool in predicting the clinical success of applicants accepted into accredited dental hygiene programs.

The research study has important implications in dental hygiene education. Applicants are often accepted into dental hygiene programs who excel academically but perform poorly in clinical and pre-clinical courses in part, due to an admissions process that is primarily based on academic or cognitive factors alone (ADHA, 2014, p. 8; Lugassy et al., 2018, p. 2). While cognitive assessments are important, they have poor predictability of clinical performance or an applicant's ability to succeed clinically (Dabaliz et al., 2017; Lugassy et al., 2018; Rudy et al., 2017). Pre-clinical and clinical course failures can also lead to increased program attrition rates (Moore et al, 2016). DEs have been proven effective in the literature as identifying students with weak or low dexterous ability (Schwibbe et al., 2016; Segura et al., 2018; Sullivan et al., 2014). The admissions process should be based on a multitude of factors that can assess both the academic and clinical ability of students. Gaining insights and perspectives as to the use, feasibility of implementation, validity, and reliability of DEs brought new information and knowledge to the discipline of dental hygiene education.

Design of the Proposed Study

A phenomenological qualitative research design was chosen for this study using semi-structured interviews. “Qualitative research is a process of naturalistic inquiry that seeks [an] in-depth understanding of social phenomena within their natural setting...focuses on the "why" rather than the "what" of social phenomena and relies on the direct experiences of human beings” (University of Texas Arlington, 2020, para. 1). Qualitative research methods allow the researcher to uncover intricate details about a participants' experience by extracting out their thoughts, feelings, and perceptions (Creswell, 2015, p. 44). Using a qualitative approach leads to a deeper understanding of the phenomenon being studied and extrapolates findings that are difficult to discover using traditional quantitative research methods.

The tool of inquiry used in this research study is phenomenology. Phenomenology is a qualitative research approach designed to, “describe the essence of a phenomenon by exploring it from the perspective of those who have experienced it. The goal [is] to describe the meaning of this experience...in terms of what was experienced and how it was experienced” (Neubauer et al., 2019, p. 91). Phenomenology is a valid and reliable tool for health professionals to explore the lived experiences and perspectives of each other (Neubauer et al., 2019).

The studies reviewed in the literature within Chapter Two included literature reviews, mixed methodology studies (a combination of quantitative and qualitative), strictly quantitative research, retrospective cohort, longitudinal, and experimental studies. A review of the research did not uncover any studies where manual DEs were used in dental hygiene programs that were solely qualitative in study design, used phenomenology as a conceptual framework, or employed interviews as the data collection instrument. In this study, the use of semi-structured interviews

as a data collection instrument allows for, “one of the most powerful ways in which we try to understand our fellow human beings” (Fontana & Frey as cited in Creswell, 2015, p. 45). The use of a phenomenological framework is appropriate in this study to gain a deeper understanding of the perceptions of dental hygiene program directors as to the use of DEs as a preadmission criterion.

Research Population and Sampling Method

Research Population

The target population chosen for this research study was dental hygiene program directors of an accredited associate or baccalaureate entry-level dental hygiene programs within the U.S. For the purposes of this study and to attain the planned number of interviews, a program director or other institutional representative, such as a department chair, dean, etc., were contacted depending on the institutional structure. Program directors have extensive knowledge of program admission requirements and the use of DEs in their program making these individuals ideal to gain perspectives from on the use of manual DEs.

Exclusions included:

1. Individuals who do not hold a position as a dental hygiene program director.
2. Dental hygiene programs outside of the U.S.
3. Programs that are not accredited by CODA.

The goal of qualitative research using a phenomenological framework and semi-structured interviews is to, “generate rich, dense, focused information on the research question” (Cleary, Horsfall & Hayter, 2014, p. 473). The researcher interviewed approximately six to eight program directors (or other institutional representatives). Fewer numbers of participants are used

in qualitative studies when compared to quantitative studies as the research or phenomena are studied more comprehensively by delving into the inner awareness and consciousness of participants. According to Cleary et al. (2014), “a small number of well-selected homogenous interviews (with adequate exposure to or experience to the phenomenon) can produce highly relevant information for analysis” (p. 473). Information gathering ceased when saturation occurred or when redundancy of information and themes began to emerge.

Sampling Method

Research participants were selected using purposeful sampling. The ADHA (2018) provides a comprehensive list of all entry-level accredited dental hygiene programs within the U.S., including directors' name, phone number, email, and dental hygiene program degrees awarded. The researcher used a type of purposeful sampling method called maximal variation sampling. Purposeful sampling can be described as purposefully selecting individuals or sites based on their ability to provide information-rich data and help the researcher gain a deeper understanding of the phenomenon being studied (Creswell, 2015, p. 205). Maximal variation sampling is a type of purposeful sampling method that helps to bring multiple perspectives to the rich data collected in the study. This is achieved by including individuals that differ in at least one characteristic or trait (Creswell, 2015, p. 206).

The aim of the study was to understand how DEs are used as a preadmission requirement in dental hygiene programs, however, only 3% report using DEs in the admissions process (Sullivan, 2014, p. 247). The researcher identified the characteristic of dental hygiene programs that are using DEs in their program and was able to interview several program directors who are currently using DEs in their programs. The perspective gathered allowed for a deeper

understanding of DE use and implementation challenges and may provide direction for other dental hygiene programs. Snowball sampling was also used in this study and can be described as a purposeful sampling method where “the researcher asks participants to recommend other individuals to be sampled” (Creswell, 2015, p. 208). Snowball sampling can be beneficial to help discover programs that use DEs and/or to identify program directors that may be willing to be interviewed.

Instrumentation

Des Moines University Library (2019) identifies a research instrument as, “measurement tools (for example, questionnaires or scales) designed to obtain data on a topic of interest from research subjects” (para. 1). Selecting the appropriate research instrument(s) is dependent on the data the researcher is trying to gather and vital to the validity of the findings. In this qualitative study, the researcher used an *Invitation to Participate* in the study (See Appendix A), a web-based questionnaire (See Appendix B), and a semi-structured interview (See Appendix C). An *Invitation to Participate* email (See Appendix A) was sent to all dental hygiene program directors of accredited entry-level associate and entry-level bachelor's degree dental hygiene programs within the U.S. The *Invitation to Participate* email introduced the researcher, the purpose of requesting participation in the study, and contained a link to a web-based questionnaire.

Questionnaires are one of the most utilized data collection instruments in health and social science research and are a convenient and quick way to gather and collect extensive data (Bolarinwa, 2015, p. 196; Creswell, 2015, p. 386). A web-based questionnaire (See Appendix B) was used to ascertain demographic data of participants, to ensure inclusion criteria were met, and to identify individual interest in participating in an interview. The link to complete the web-

based questionnaire was contained in the *Invitation to Participate* email. The web-based questionnaire consisted of approximately nine questions and took five to seven minutes to complete. The questionnaire was accessible to participants for two weeks.

Interviews are a beneficial way to uncover a deeper understanding of a phenomenon as the use of open-ended probative questions allow participants to reflect on their thoughts and process how they experienced and felt about the phenomenon being studied (O’Keeffe, Buytaert, Mijic, Brozovic & Sinha, 2016). “Participants can be regarded as experts by experience; therefore, when sufficient opportunity to speak freely is provided, new and novel information can emerge” (O’Keeffe et al., 2016, p. 1913). Semi-structured interviews, as opposed to structured interviews, were used for this research study. The face to face, telephone, Skype or Zoom interview consisted of approximately 10 open-ended questions relating to DEs as a preadmission criterion.

In structured interviews, the interviewer asks closed-ended questions and does not use probes to uncover deeper information and understanding beyond the answers received (McLeod, 2014). Conversely, semi-structured interviews are structured more like a guided conversation (McLeod, 2014). Open-ended questions are used allowing the researcher to use probes to extract additional detail, clarification, or understanding of the phenomenon being studied (McLeod, 2014). The semi-structured interview is more flexible in design allowing participants to speak freely of their own volition (McLeod, 2014). As this design allows for the deep interviewing of participants, which lends itself to uncovering rich data about the phenomenon or characteristic being studied, the semi-structured interview is the researcher's choice of interviewing technique.

Data Collection

Using an inclusive list from the ADHA (2018) of all entry-level accredited dental hygiene programs in the U.S., the researcher emailed invitations with a link to a web-based questionnaire and informed consent to all associate's and bachelor's dental hygiene program directors or other institutional representatives. The web-based questionnaire collected demographic information, ensured inclusion criteria were met, and identified volunteers willing to be contacted by the researcher to schedule an interview. A two-week response time was allotted for the return of the web-based questionnaires, at which time the researcher used maximal variation sampling to select participants based on a balanced number from each geographic location. The researcher interviewed one or more program directors who are currently using DEs in their program. Remaining participants who agreed to an interview stayed in a pool for possible future selection due to attrition.

Participation was voluntary and informed consent was obtained for all participants who agreed to take part in the study. The researcher scheduled eight semi-structured interviews by phone and/or email. Semi-structured interviews were conducted via telephone and averaged 30 to 45 minutes in duration.

Once consent was given, the researcher conducted semi-structured interviews (See Appendix C) to question dental hygiene program directors about their perceptions and experiences with the use of manual DEs in their program. The researcher audio recorded the sessions using a digital recorder while taking notes on an interview protocol sheet (See Appendix D). Audio recordings were transcribed using NVivo transcription software. NVivo transcription software is encrypted, General Data Protection Regulation (GDPR) and Health Insurance Portability and Accountability Act (HIPAA) compliant and is not modified or shared with third

parties (NVivo, 2019, para. 1-6). The researcher also used member checking. “Member checking is a qualitative process during which the researcher asks one or more participants in the study to check the accuracy of the account” (Creswell, 2015, p. 259). Once semi-structured interviews were completed, audiotaped, and transcribed, a copy of the interview was emailed to those participants who specifically requested to evaluate the transcript for accuracy. Participants were asked if the transcript is a fair and representative account of their own words, perceptions, attitudes, and feelings regarding DEs. The participants were given 7 days to review the transcript and email comments to the researcher. The process of member checking allowed for participants to edit, add, or clarify the data and its meaning, ensuring accuracy of data analysis and interpretation (Creswell, 2015, p. 259).

Identification of Attributes

This study was qualitative in nature using phenomenology as the conceptual framework. Some of the attributes of this study, based on the research design, include the use of a semi-structured interview with open-ended questions and the researcher as the instrument by which the data was collected, analyzed, and interpreted. The data was interpreted based on the full and honest accounts of the participants, and the researchers and participants share the research space. Mindfulness of these attributes will help guide and direct the study.

Data Analysis and Procedures

Once all audio data was transcribed using NVivo software, participants who requested to review their transcript for accuracy were sent an electronic copy of their transcript with a return email request for comments within 7 days. In addition, the researcher analyzed the interview data and begin the process of coding. “Coding is the process of segmenting and labeling texts to form descriptive and broad themes in the data” (Creswell, 2015, p. 242). This was achieved by

reading the transcripts several times and getting a sense of the tone of the interview. Once achieved, the researcher began to identify important terms or text segments, highlight, and assign a code (word, color, or phrase), and began to extract commonly identified themes (Creswell, 2015, p. 242). As redundancies in the thematic analysis were eliminated, themes were further broken down until codes were reduced to a lesser number of broad-based themes (Creswell, 2015, p. 242). See Figure 3 for a visual model of the coding process in qualitative research as suggested by Creswell (2015).

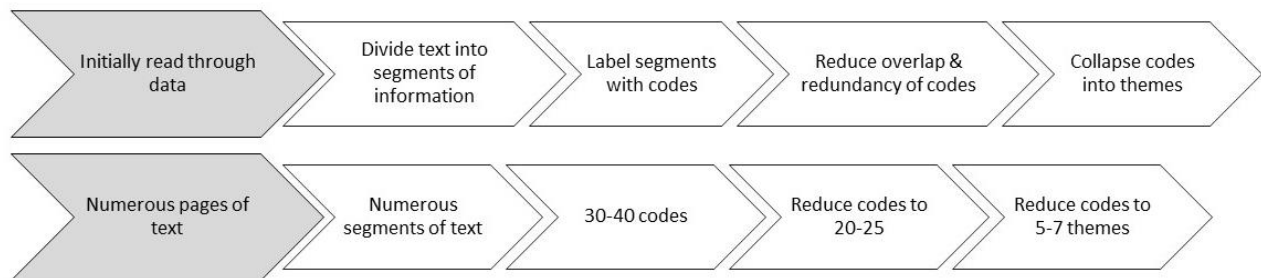


Figure 3. A visual depiction of the coding process used in qualitative research. Modified from “Educational Research: Planning, conducting and evaluating quantitative and qualitative research,” by Creswell, J. (2015). Chapter 8: Analyzing and interpreting data. Retrieved from <https://slideplayer.com/slide/10584606/>.

The researcher took part in a code-recode strategy which involved coding the data two times on two separate occasions with a grace period of one or two weeks in between each coding analysis. Codings from both analysis sessions were compared for consistency in codes and themes. Results that were similar improve the dependability of the study (Anney, 2014, p. 278).

Limitations of the Research Design

Limitations

A limitation can be described as certain constraints beyond the control of the researcher that has the potential to impact the outcome of the study (Goes & Simon, 2015, p.2). The researcher used semi-structured interviews as an instrument to collect data based on the conceptual framework of phenomenology. Due to the time consumed using deep interview techniques, a small sample size was used. A small sample size could compromise generalizability as the data collected may not be representative of the thoughts and attitudes of all dental hygiene program administrators in the entire U.S. Moreover, the results may be not generalized to other healthcare disciplines and academic programs.

The use of a phenomenological study design using semi-structured interviews also bears a limitation. In this study design, the researcher is the instrument by which data is being collected allowing for subjectivity when interpreting results. To alleviate bias, the researcher took part in the process of bracketing and reflexivity to gain a deeper understanding of her own thoughts, knowledge, and perceptions of DEs through reflexivity journaling and putting those preconceptions aside to maintain objectivity in the data collection and analysis process. Lastly, this study explored only one variable, DEs, and not multiple cognitive and non-cognitive variables as a preadmission criterion for entrance into dental hygiene programs, to maintain a singular area of research focus.

Delimitations

A delimitation can be described as, “the characteristics that arise from limitations in the scope of the study and by the conscious exclusionary and inclusionary decisions made during the

development of the study plan....delimitations result from specific choices made by the researcher” (Goes & Simon, 2015, p.4). This study addressed the admission variable of manual dexterity in an effort to keep the study focused. Addressing other variables such as academic test scores, applicant interviews or shadowing would not be feasible making the study too broad in scope and depth. Additionally, phenomenology is the contextual framework used for this research study and involves complex and comprehensive deep interviewing techniques. As such, it is not feasible to interview all dental hygiene program administrators on a national level. Therefore, an additional delimitation was the small sample size used in the study which may cause a lack of transferability.

Validation

Credibility

Credibility can be defined as, “a measure used to find out whether the research findings characterize a “credible” conceptual explication of the data taken from the research participants’ original data” (Lincoln & Guba as cited in Mohd-Ali, 2016, p. 184). More simply stated, “confidence in the truth of the finding(s)” (Lincoln & Guba as cited in Amankwaa, 2016, p. 121). As a researcher, ensuring the interpretations of the data accurately reflect the views and shared experiences of the participants is paramount; otherwise, the goal of phenomenographic research will be compromised. Several methods can be used to establish credibility in qualitative research studies. Lincoln and Guba (as cited in Amankwaa, 2016) identified the following methods as adjunctive in establishing credibility: prolonged engagement, persistent observation, triangulation, peer debriefing, negative case analysis, referential adequacy, and member-checking (p. 122).

To ensure credibility, the methods the researcher used persistent observation, member checking, bracketing, reflexive journaling, and triangulation. Persistent observation required the researcher to be open, receptive, and attentive to the tone and feelings portrayed by the research participants and/or phenomenon being studied (Cope, 2014, p. 90). Taking part in persistent observation allowed the researcher to listen more deeply and reflectively to the participants' account of the phenomenon being examined, providing greater depth to the study.

Member checking is an additional method in which the transcription, or participants' accounts, can be checked for accuracy, improving credibility. After transcriptions were complete, participants had an opportunity to check the account of their interviews. The process of member checking allowed for participants to make revisions and provide clarification of ideas that may have been misinterpreted. Member checking is regarded as one of the most fundamental methods needed for establishing the credibility of a study (Lincoln & Guba as cited in Amankwaa, 2016, p. 122).

Bracketing can be described as the process used in phenomenological inquiry where researchers intentionally put aside their own beliefs, attitudes, experiences, and existing knowledge about the phenomenon under investigation so as not to influence the data and be able to accurately describe it with minimal bias (Chan, Fund & Chien, 2013, p.1). The researcher took part in bracketing through the careful reflection of individual perceptions and attitudes and putting preconceived notions aside that surround DEs. This allowed for a continued curiosity and inquiry on the part of the researcher and engagement in a deep interviewing process.

The researcher used reflexive journaling throughout the research study allowing for notetaking and reflection of thoughts, feelings, and perceptions regarding DEs. Bracketing and

reflexivity were achieved through the careful reflection of the beliefs and perceptions of the researcher, asking broad open-ended questions without leading the participant, and keeping a reflexive journal to re-examine the thoughts and attitudes of the phenomenon being studied that may influence the themes and conclusions drawn from the research (Chan et al., 2013). Both bracketing and reflexive journaling increased researcher objectivity and reduce bias.

Triangulation is a method that can be used to validate the accuracy of research findings (Creswell, 2015, p. 258). Creswell (2015) describes triangulation as, “the process of corroborating evidence from different individuals...types of data...or methods of data collection in descriptions and themes in qualitative research” (p. 259). By examining a bevy of information sources, the researcher uncovered a collection of evidence to support the theme(s) identified and drawn from the data (Creswell, 2015, p. 259). Taking part in triangulation assisted the researcher in corroborating consistent findings from various data sources to generate results that are accurate, credible, and valid.

Dependability

Dependability can be described as the reliability of data or “showing that the findings are consistent and could be repeated” (Lincoln & Guba as cited in Amankwaa, 2016, p. 121). The element of dependability relies on the stability of the data; that is if another researcher were to analyze the raw data of a study, would the same interpretations, themes, and results be concluded? Methods to enhance the trustworthiness and dependability of a study are an important element to improve validity. Anney (2014) asserted several methods can be implemented to improve the dependability of a study such as, but not limited to, developing an

audit trail, a code-recode strategy, stepwise replication, triangulation, and peer examination or iterator comparisons (p. 278.).

The researcher took part in triangulation and used a code-recode strategy to increase dependability. Code-recode strategy involved the researcher coding the data two times on two separate occasions with a grace period of one or two weeks in between each coding analysis. Codings from both analysis sessions were compared for homogeneity. If results are similar in nature, dependability of the study is enhanced (Anney, 2014, p. 278).

Transferability

Transferability can be described as the ability to show, “that the findings have applicability in other contexts” (Amankwaa, 2016, p. 121). Contexts of transferability in this study included additional dental hygiene and dental programs across the U.S. Transferability may not be applicable in the context of healthcare professions that are outside of dental hygiene and dentistry. Transferability can be achieved in qualitative research through the process of thick description and purposeful sampling (Amankwaa, 2016; Anney, 2014). Thick description involves collecting abundant amounts of robust data, capturing the details, and discussing the fine points surrounding the phenomenon being studied (Amankwaa, 2016, p. 122). A thick description provides a clear picture for readers of the events that took place in the research, a design to potentially replicate in future studies, and is a way in which external validity can be accomplished (Amankwaa, 2016, p. 122).

The researcher employed a qualitative research design using a phenomenological framework and semi-structured interviews which is a way to, “generate rich, dense, focused information on the research question” (Cleary et al., 2014, p. 473). Participants had the

opportunity to access their inner consciousness, individual experiences, and thoughts as to how those experiences were perceived which will provide rich, robust, and detailed data leading to a thick description.

The researcher also used purposeful sampling in this study design, specifically maximal variation sampling. Purposeful sampling involves purposefully selecting participants based on their ability to provide information-rich data while maximal variation sampling is a type of purposeful sampling method that helps to bring multiple perspectives to the rich data collected (Creswell, 2015, p. 205). This is accomplished by identifying at least one trait or characteristic (in this case the use of DEs as a preadmission requirement) and attempting to identify participants who exhibit this characteristic (Creswell, 2015, p. 205). According to Anney (2014), “when the researcher provides a detailed description of the enquiry and participants were selected purposively, it facilitates transferability of the inquiry” (p. 278).

Expected Findings

Through this qualitative study, it was expected the data would yield a deeper understanding of the use of DEs in accredited dental hygiene programs as a preadmission criterion. With only 3% of the 323 accredited dental hygiene programs reported as using a type of manual DE as part of the admissions process (ADA as cited in Sullivan et al., 2014), it was expected reasons for not using DEs would emerge as a major theme. Using maximal variation purposeful sampling the researcher included study participants who do and do not use DEs in their programs as a preadmission criterion. It was expected the barriers and obstacles facing dental hygiene programs regarding use and implementation would be uncovered. This information can have a positive potential impact on other dental hygiene programs as perceptions and insights will cultivate new knowledge as to how to overcome some of the challenges that

accompany DEs and their use. Lastly, it was expected the perceptions surrounding the validity and reliability of DEs as a tool to evaluate manual dexterity would be discovered. This information may provide reasons for the lack of use of DEs in dental hygiene programs.

Ethical Issues

Conflict of Interest Assessment

A conflict of interest can be described as, “circumstances that create a risk that professional judgments or actions regarding a primary interest will be unduly influenced by a secondary interest” (Romain, 2015, p. 123). Due to the study being phenomenological in nature, subjectivity on the part of the researcher can occur. Researchers can bring their own perceptions, knowledge, attitudes, and feelings about the phenomenon being studied to the data collection and analysis process. This bias can skew data and cause inaccurate conclusions to be drawn from the research findings. To alleviate researcher bias, the researcher took part in bracketing and reflexivity. By reflecting on personal attitudes and perceptions about DEs through reflexive journaling from inception to conclusion of the study, the researcher was able to place aside thoughts and feelings regarding DEs. Moreover, the researcher avoided using leading questions in the semi-structured interviews, maintained objectivity throughout the duration of the study, and sustained a continued curiosity throughout the semi-structured interviews allowing participants to share their inner thoughts freely. Lastly, to avoid researcher bias and thwart potential conflict of interest, the researcher did not interview the department chair at the institution where the researcher is employed.

Researchers Position

The researcher completed this study in partial fulfillment of a doctoral degree in health sciences and is receiving no monetary compensation. It is the position of the researcher that no deception was used in the research process. The research took place in an ethical and scholarly manner as outlined in the design of the proposed study, research population, sampling method, instrumentation, data collection, and data analysis procedures section of this chapter. Potential participants were informed about the details of this study through the *Invitation to Participate* in the study email (See Appendix A). The researcher will use the data collected from this study to provide dental hygiene programs with expanded knowledge of DEs, their use, and perceived validity and reliability as a tool to assess the manual dexterity of dental hygiene applicants.

Ethical Issues in the Proposed Study

After obtaining IRB approval from the University of Bridgeport to conduct this study, the *Invitation to Participate* email with a link to the survey and informed consent was distributed via email to potential participants. To preserve participant anonymity in the research report, each participant was assigned a letter to be used in the data collection process to avoid linking responses to individual participants. No personal identifiers such as, individual participant name or the name of the institution employer, will be used in any reports or future publications resulting from this study. The only markers of identification used in this study were for demographic purposes such as, but not limited to, gender and four broad regional geographical location categories which will include: the Northeast, the Midwest, the South, and the West. These steps were taken to ensure the anonymity of research participants.

The principal researcher is the only individual who had access to participant recordings and data files collected in this study. Once the recording was transcribed, it was erased. Signed consent forms, paper copies of interview transcripts, and all other research information was stored in a locked safe. Data will be deleted and shredded within three years of initial collection. The results of this study may be published as articles in professional journals or presented at professional conferences however, as previously stated, no identifying characteristics will be used preserving anonymity. In addition, no references will be made in oral or written reports that could link a research participant to this study.

Chapter 3 Summary

Chapter Three communicated in detail the research study purpose, design, research population, sampling method, instrumentation for data collection, data collection and analysis procedures, limitations of the research study, ethical issues, and how the researcher planned to thwart such issues and maintain ethics. This research study used a qualitative phenomenological approach, employing purposeful maximal variation sampling to understand how DEs are used as a criterion for preadmission into accredited dental hygiene programs within the U.S. This study explored the perceptions regarding their validity and reliability as a tool to assess the manual dexterity or fine motor skills of students. Phenomenological research is an ideal approach when seeking to “describe the essence of a phenomenon by exploring it from the perspective of those who have experienced it” (Neubauer et al., 2019, p. 91). Data collected from this study will inform and provide valuable insights to the dental hygiene education community as it relates to DEs and their use in dental hygiene programs.

Chapter 4: Data Analysis and Results

The purpose of this study was to identify how DEs are used as a criterion for preadmission into dental hygiene programs, to identify any challenges and obstacles associated with their use, and determine if DEs are perceived as a valid and reliable tool to assess the fine motor skills of dental hygiene applicants. This study was qualitative, focusing on transcendental phenomenology, which is centered around the inner consciousness of individuals, their experiences, and how those experiences are perceived and regarded by the individual who is experiencing them (Smith, 2018). This chapter will focus on the description of the sample population, the research design, the data collection method and data analysis, the presentation of key findings, the emergent themes identified, and secondary findings.

Description of the Sample

Sample participants included dental hygiene program directors from accredited programs in the U.S. A recruitment email (See Appendix A) with a link to a demographic survey was sent to 327 accredited dental hygiene program directors. Purposeful sampling was used to select a total of eight interview participants ($n = 8$) from the 62-participant pool. The research participants in this study were all female dental hygiene program directors working at accredited associate and/or baccalaureate entry-level dental hygiene programs within the U.S. The states within the country were divided into four smaller subcategories of West, Midwest, South, and Northeast (See appendix E). Two participants from each geographical subcategory were selected to yield a diverse sample that is representative of the overall population group. Additionally, maximal variation sampling, a type of purposeful sampling, was used to select participants who use DEs as a preadmission criterion. The aim of this study was to understand how DEs are used as a preadmission requirement in dental hygiene programs and since only 3% of accredited

programs report using DEs in the admissions process (Sullivan, 2014, p. 247), it was important to interview participants who use DEs as a preadmission criterion. Their perspectives allowed for a deeper understanding of DE use, implementation challenges, and may provide direction for other dental hygiene programs.

Demographic Data

After the recruitment letter was emailed to the dental hygiene program directors, participants were given two weeks to complete the survey. However, as the surveys were sent over the winter break in January, many faculties were out of the office slated to return at the start of the spring semester which varied by institution. As a result, the *Invitation to Participate* email was resent to 34 participants who were given an additional week to participate and complete the survey.

Population Demographic Data

Surveys were sent electronically to 327 accredited dental hygiene programs in the U.S. Seven emails were undeliverable, not found, or blocked from access. Seventy-one surveys were returned, however, only 62 of the 71 surveys were completed for a 22% response rate. Of the 62 respondents, 60 were female and two were male. Nineteen participants were in the Midwest, 19 in the South, 13 in the West, and 11 in the Northeast (See Appendix E). Three of the 62 participants, or 4.8%, reported using a DE as a preadmission criterion in their program which is consistent with previously reported data (ADA as cited in Sullivan et al., 2014).

Demographic data collected (n = 62) also included the age of the participants and their position or title. Forty-five participants held the title of program director with three between the ages of 25-35 years old, 14 participants were between the ages of 46-55 years old, and 28

participants were 56 years old and over. Thirteen individuals held the title of department chairperson with one participant between the ages of 36-45 years old, seven participants were between the ages of 46-55 years old, and five participants were 56 years old and over. Three participants held the title of dean with two participants between the ages of 46-55 years old and one participant 56 years old and over. One participant listed a title as *other* and indicated an age of 56 and over (See Table 1).

Table 1

Position Held by Research Participants and Their Age Range. (n = 62)

Position or Title Held	Frequency of Individuals Per Age Category in Years				Total Number of Participants in Each Position
	25-35	36-45	46-55	56 and over	
Program director	3	0	14	28	45
Department chairperson	0	1	7	5	13
Dean	0	0	2	1	3
Other				1	1
Total	3	1	23	35	62

Note. The participant in the *other* category serves as both the dean and program director.

Participants were also asked how many years they were in their prospective roles as program director, department chairperson, or dean. Twenty-three participants (37.1%) reported holding their position for 1-3 years. Seventeen participants (27.4%) reported holding their position for 4-6 years. Lastly, 22 participants (35.5%) reported holding their position for 7 or more years (See Table 2).

Table 2

The Number of Years Research Participants are Currently Serving in Their Role as Program Director, Department Chairperson, or Dean. (n = 62)

Years in Position	Frequency	Percent (%)
1-3	23	37.1
4-6	17	27.4
7 or more	22	35.5
Total	62	100.0

Additionally, research participants (n = 62) were asked what degrees are offered by their academic institution. Forty participants (64.5%) reported offering an entry-level AAS program, eight participants (12.9%) reported offering an entry-level AS program, and 10 participants (16.1%) reported offering an entry-level BS or BA degree. Three programs (4.8%) offer both an entry-level AAS and BS or BA program and one (1.6%) offers both, an entry-level AS and an entry-level BS or BA (See Table 3).

Table 3

Degrees Offered at Research Participants Institutional Employer

Degrees Offered	Frequency	Percent (%)
Entry-level AAS	40	64.5
Entry-level AS	8	12.9
Entry-level BS or BA	10	16.1
Both, an entry-level AAS and an entry-level BS or BA	3	4.8
Both, an entry-level AS and an entry-level BS or BA	1	1.6
Total	62	99.9

Note. The total percentage does not equal 100 due to rounding to the tenths decimal place.

All research participants (n = 62) were asked if they would be interested in participating in a brief interview at a mutually agreed time. Twenty-two participants (35.5%) indicated “yes,” 22 participants (35.5%) indicated “no,” and 18 participants (29%) indicated “maybe.” Also, participants were asked if the researcher could contact them to schedule an interview. Thirty-seven participants (59.7%) answered “yes” with 25 participants (40.3%) answering “no.”

Interviewee Demographic Data

The sample profile of the research participants (n = 8) consisted of all females, five who were in their position for 1-3 years, one who was in their position for 4-6 years, and two who were in their position for 7 or more years. Geographically, two participants were from each geographic subcategory of the West, Midwest, South, and Northeast. Also, three of the eight research participants use DEs as a preadmission criterion. Concerning the interview participants’ institution, one program offers dual degrees of an entry-level AAS and an entry-level BS or BA, two offer an entry-level AS, four offer an entry-level AAS, and one offers an entry-level BS or BA (See Table 4).

Research Methodology and Analysis

A qualitative research design using a transcendental phenomenological approach formed the basis for data collection in the study. As the intent of the study was to gain a deeper understanding of the use of DEs as a preadmission criterion, a qualitative design using phenomenology as a conceptual framework was chosen. The researcher collected data by emailing an invitation to potential research participants. This email contained a survey link to a questionnaire to collect demographic data and inquire about participant interest in being interviewed. After 37 participants agreed to be contacted for an interview, purposeful sampling was used to select eight participants to contact and schedule interviews. Semi-structured

interviews were performed, recorded, and transcribed using NVivo transcription software.

Research participants were given the opportunity to participate in member checking. Member checking is a process whereby research participants take part in reviewing the accuracy of their interview once transcribed improving the credibility of the data collected. Five of the eight participants requested to take part in member checking. Transcripts were emailed and participants returned their responses within the allotted one week. Upon receipt, transcriptions were coded, and a thematic analysis was performed.

Table 4

Profile of Research Participants. (n = 8)

Assigned Participant Letter	Gender	How Long Employed in Position (years)	Geographic Subcategory	Degrees Offered	Uses a DE as a Preadmission Criterion
A	Female	1-3	West	Entry-level AAS Entry-level BS/BA	Yes
B	Female	1-3	Northeast	Entry-level AS	No
C	Female	1-3	Midwest	Entry-level AAS	No
D	Female	1-3	South	Entry-level BS/BA	Yes
E	Female	1-3	Northeast	Entry-level AAS	No
F	Female	4-6	South	Entry-level AAS	No
G	Female	7 or more	Midwest	Entry-level AAS	No
H	Female	7 or more	West	Entry-level AS	Yes

Note. MDE denotes manual dexterity examination

Recording, Transcription, and Coding of Data

Recording the data. All interviews were completed over the phone at a mutually agreed time for the participant and the primary researcher. Data was recorded using an audio recording

device. While interviewing participants, the researcher took notes on an interview protocol sheet (See Appendix D) as an additional safeguard should there be a malfunction with the audio equipment and to capture any emotions or emphasis that may be easily overlooked when reviewing the transcription and performing analysis.

Transcribing the data. The audio recording was uploaded to the online transcription software platform NVivo. Once uploaded, the researcher reviewed each transcription for correctness as certain terms and phrases were not transcribed correctly and others were not recognizable in the NVivo software database. Each participant was assigned a letter to ensure anonymity during the analysis and writing process. Once all transcriptions were reviewed for accuracy, the researcher sent the transcripts via email to the five participants who requested to participate in member checking. No revisions or edits were made by individual research participants to their respective transcriptions.

Coding the data. Once the transcriptions were completed, the researcher began the process of coding the data. According to Creswell (2015), “coding is the process of segmenting and labeling text to form descriptions and broad themes in the data” (p. 242). Using different colors, the researcher highlighted broad-based statements of similarity and placed brackets around relevant text segments. After removing repetitive codes, the researcher re-coded the transcripts to see if different codes or text segments were identified as relevant and to further reduce the codes into themes. The researcher used a code-recode strategy to improve the dependability of the data by coding the data two times on two separate occasions with a grace period of one to two weeks in between the coding analysis process. The codes from both analysis sessions were compared for consistency and a thematic analysis was completed. Five

primary themes emerged based on the codes and text segments extracted from participant transcripts (See Figure 4).

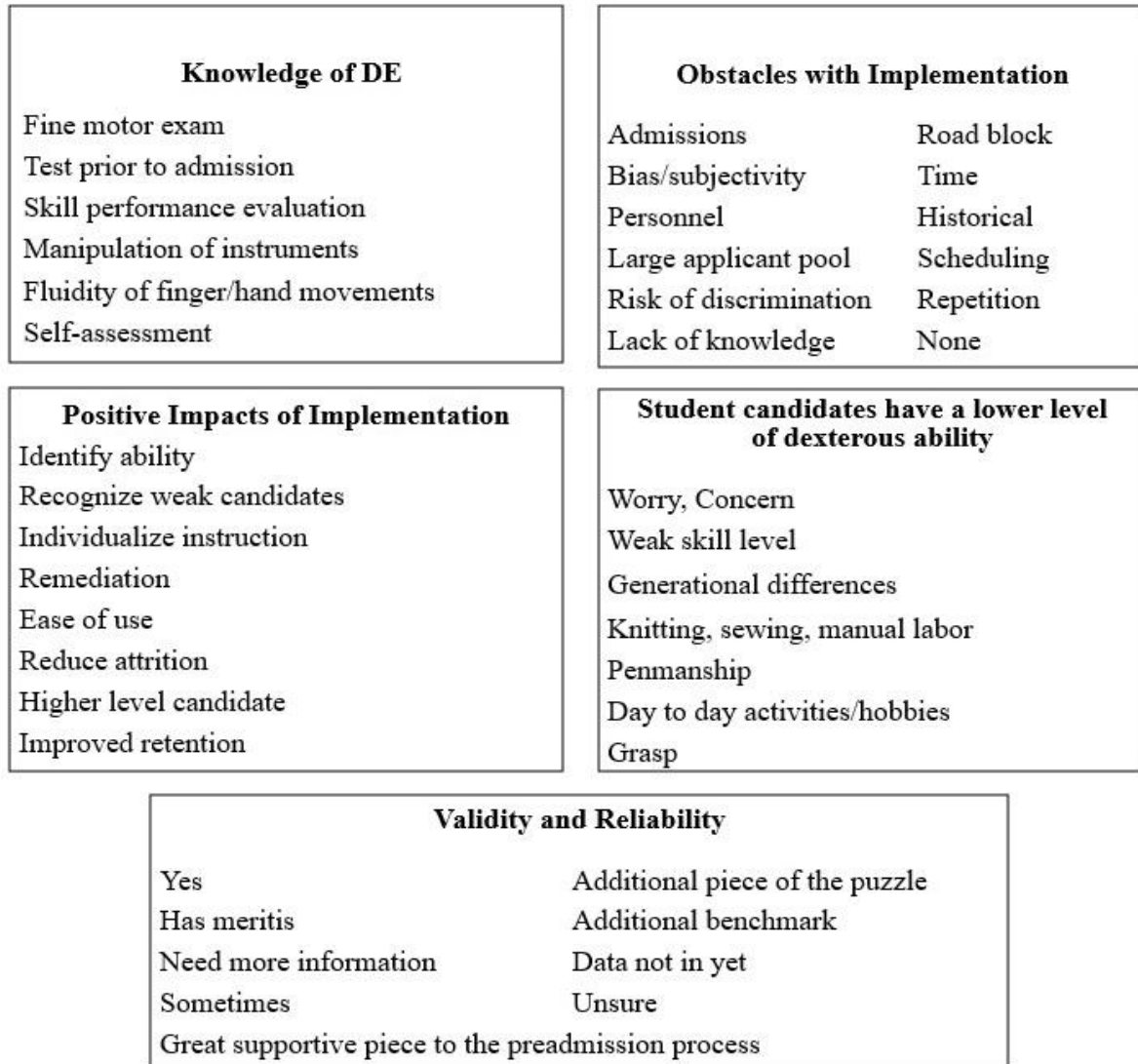


Figure 4. Schematic of the five themes and corresponding text segments identified during the coding process.

Summary of the Findings

Data collected and discussed in this section was gathered using semi-structured interviews. The semi-structured interviews asked open-ended questions about the use of DEs as a preadmission requirement in dental hygiene programs and the perceptions, feelings, and experiences of participants regarding this assessment tool. These discussion points formed the basis of themes to emerge surrounding this topic (See Figure 4). Five main themes and seven subthemes emerged. The five primary themes included knowledge of DEs, obstacles with implementation, positive impacts of implementation, student applicants have a lower level of dexterous ability, and validity and reliability. The second theme, obstacles with implementation, includes four subthemes, repetitive use of the same DE, admissions, quantity of applicants to screen, and historical reasons. The third theme, positive impacts of implementation includes three subthemes, identifying the dexterous ability of potential applicants, ease of use to administer, and a reduction in attrition rates. The primary themes and subthemes will be discussed in the next section.

Presentation of the Data and Results

Theme 1: Knowledge

Participants were asked to describe in their own words what a DE is and what it is used for. Seven out of eight participants expressed some knowledge of DEs stating that a DE has to do with the manipulation of dental instruments by students to perform a skill that would be evaluated to some degree (Participants A, B, C, D, E, F, and H). Participant G indicated that although she could not exactly describe what a DE is, she imagined it would be the use of instruments and students' dexterity and how they hold and manipulate them. Participant A described a DE to be the following:

When the candidate has to perform skill given to them while they are being basically watched by the ones participating in the interview and then they're graded on that [skill], to see their performance, looking at how they, 1. follow direction, 2. are they able to perform the skill correctly and...do they have the confidence, and maybe not the proficiency at that particular point, to perform...under pressure...completing it at the best of their ability.

Participant B described a DE as an exam given to identify the dexterous ability of students. "If a student was applying to some sort of program that required dexterity, to really get an idea of do they have the dexterity skills...the very fine-tuning skills that would translate to being a clinician working in a small space" (Participant B). Similarly, Participant C described a DE as the following:

An exam that would be a test that a student would take prior to admission in this case, into the dental hygiene program and it would probable use a battery of tests to see...their ability to manipulate your hands, be able to perform some of the functions that we do as dental hygienists, and being able to maneuver with our hands and perform instrumentation actually on a later date...for admissions into the program is what I would assume it is used for.

Participant E described a DE as the following: "I perceive it to be some type of an examination where a student can, an incoming possible student can manipulate fine motor skills, so there's critical thinking and fine motor to an endpoint of some type of application."

Theme 2: Obstacles with Implementation

Participants who are using or who have used DEs as a preadmission requirement were asked to discuss obstacles or challenges encountered during implementation. One emerging

subtheme regarding obstacles to implementation has been the repetitive use of the same DE year after year potentially leading to a applicants ability to practice the skill asked to be performed by the academic institution prior to the assessment of fine-motor skills. Participants who are not using DEs as a preadmission requirement were asked to discuss reasons that may be preventing their program from implementing this assessment tool. The primary sub-themes that emerged were institutional admissions poses a challenge to approve the use of a DE as a preadmission requirement, the ability to provide a DE for each potential applicant who applies to the program is cumbersome when the applicant pool is large, and the lack of use of a DE in the previous history of the department. An expanded explanation of each subtheme will be provided.

Repetitive use of the same DE. There is a myriad of DEs institutional programs can choose from as a preadmission assessment tool depending on the specific need of the department and the skill sought to be assessed. Once a DE is decided upon and used annually for successive years, there is an increased risk that details of the DE used by the institutional program may spread within the community to future program applicants. Participants A and D both reported one of the challenges they face with implementing a DE as a preadmission requirement is applicants having previous knowledge of the exam. “We’re looking at coming up with something different because the word has kind of gotten around about what we do and what the students need to look for” (Participant A). “As with anything else, word gets out so they’ve [the dental hygiene applicants] gotten better at that [taking the DE] over the last couple of years” (Participant D). Repetitive use of the same DE allows for the candidate to know what to look for and to potentially practice the skill they are being tested on before taking the DE.

Admissions. When selecting a preadmission requirement for a program, institutional admissions administrators generally have the power to grant or deny approval of a requirement.

Admissions requirements are intended to be objective and prevent bias from being introduced into the preadmission process. A concern in using DEs as a preadmission requirement is the risk of discrimination and/or the perception of some degree of subjectivity which may cause admissions administrators to not approve its use. Research participants shared some concerns as it relates to obstacles that are encountered with admissions administrators. Participant G stated that implementing the use of DEs would be one more thing to include in the preadmission process and administration of the academic institution always presents an obstacle or obstruction with the adoption of new criteria. “They are always a roadblock anytime when you try to do anything...our administration...they’re not very supportive” (Participant G). Participant E commented on the potentially discriminatory nature of using a DE and whether it is a true representation of a prospective candidate's dexterous ability as there is the potential to improve upon individual dexterous skill.

[What] I worry about is it an accurate snapshot at a moment of time that would discriminate on a skillset where possibly, if they were entered into the program, I could build on that fundamental or that fine motor [skill] by maybe some type of exercise or physical training or just being seasoned and offering targeted remediation instruction. I don’t know how my college, or the administration would support this [DE] so that would be...another barrier. (Participant E)

Participant F also commented on the admissions policy at her institution being a concern. “I think that...one of the problems is with our admissions process, that is...we will admit all students.”

Quantity of applicants to screen. The admissions process for dental hygiene programs is highly competitive. This is due to two main factors; most dental hygiene programs have a maximum enrollment cap and applicants often triple the number of spots available for admissions (ADHA, 2014). Participant D reported having as many as 200 applicants while Participant E reported having between 250 – 300 applicants each academic year. In addition, programs are accepting anywhere between 20 and 50 plus applicants each year depending on the dental hygiene program. Participants reported that providing a DE for each potential applicant applying to the program can be daunting and unmanageable.

My first question is, who would be the one who would be conducting the dexterity exam and who would have to be there for, you know, if we get 90 applicants when would these dexterity exams get scheduled, and then am I responsible for administering the exam to all of these potential candidates? I think the personnel aspect of it and the scheduling [of the DEs] are the two biggest [reasons for not implementing DEs into the preadmission process]. (Participant B)

Participant C expressed similar concerns regarding the time needed to provide DEs to the large applicant pool her program receives each year. “Probably one of the big criteria...and why we haven’t even considered it [using DEs as a preadmission requirement], is because of the number of our applicants. We get about 110 applicants into the program...[it would be] cumbersome for sure” (Participant C). Navigating through the time and faculties needed to administer DEs has presented as an obstacle for several research participants.

Historical reasons. DEs not being used as a preadmission criterion for entrance into a dental hygiene program is an additional subtheme that emerged as an obstacle with

implementation. When asked about reasons preventing the use of a DE in the program, Participant C stated, “To be honest with you...for historical reasons, that it’s never been used [previously in the history of the program].” Similarly, Participant F remarked that “the program has never used dexterity exams and I cannot tell you the reason behind that, I don’t know that any...college in the state uses dexterity exams”. Programs that are running successfully may not see a need to implement new preadmission requirements that require additional time and effort to the department, rather, implementing new criteria may be perceived as counterproductive.

Theme 3: Positive Impacts of Implementation

Participants who use DEs as a preadmission requirement were asked to discuss any positive impacts of implementation. Three subthemes emerged from the discussion: 1) identifying the dexterous ability of student applicants, 2) ease of use to administer, and 3) reduction in attrition rates. An expanded explanation of each subtheme is provided as follows:

Identifying the dexterous ability of student applicants. The capability of DEs to identify the dexterous ability of applicants has presented as an emerging subtheme. Participant A stated that while an applicant’s skill is not expected to be at a proficient level, the DE allows for several key elements to be discovered, to see if the student can follow directions, look in the mirror and perform indirect vision, and view instrument grasp for correctness. “Are we going to have trouble with getting them to hold that modified pen grasp? Can they look in the mirror and possibly do some indirect” (Participant A). In addition, Participant A stated, “It did kind of give us a pre-look at what might cause some problems down the road.” Participant A also explained the examiner can be alerted to other issues that can cause potential problems with fine motor skill

and instrument manipulation such as vision impairment and depth perception issues which the department would not be made aware of until the applicant was accepted into the program.

I think the positive [of implementing DEs as a preadmission requirement] would be that we really were able to kind of catch some potential issues with students right away. The dexterity is not going to be there yet but vision issues, that if they really have issues with depth perception. We noticed a couple things like that because of course they don't divulge that information on their application...but I think we were able to kind of steer clear of some of those students, unfortunately, that would probably really struggle in the program. (Participant A)

Participant H expressed implementing a DE was positive as it gives you an idea as to the dexterity level of the students coming into the program; "it is a benchmark and it does keep out the ones who really have no skills and those are what impact our program from moving forward." Participant D expressed using DEs as a preadmission requirement could help to identify students having weak dexterous skills which could lead to individualized instruction or clinical remediation to improve fine motor skills.

I can think of one student in particular...her tracing [on the MDE] was [not great] but her assessment of it [her performance] was spot on though. We knew that she coming in was going to be someone that we were going to have to keep an eye on and it enabled us to sort of pair her up with someone that had worked in a dental office before, and much older, and had more experience. She is getting ready to graduate and is a 4.0 student. (Participant D)

Participant D also discussed the importance for students to be able to self-evaluate their clinical skills. Giving a DE as a preadmission requirement allowed Participant D to not only see the students' dexterous ability but how well they can self-assess.

I have a calibrated maze [as a DE] and what we did for the first couple of years is [use the DE for] self-assessment. So, we would have them do it and then we would say, okay, on a scale of 1 to 10 rate yourself. How did you do...and then after they leave the room, that's when we would see it [the applicants' DE]. I will find their [DE] and I will hold it up and we'll...all [talk] about their ability to self-assess. We would look at it and go either, yeah, they're right on, they're pretty good at self-assessment or I'm a little more worried about that one [student ability to self-assess]. (Participant D)

Even though the student performed poorly on the DE, the student was able to reflect and self-assess his/her ability. This student was viewed as teachable. With faculty knowing the initial dexterous ability was low, they were able to pair the student with a more seasoned clinical faculty to aide in monitoring and developing the student's clinical progress and skill.

We want teachable students, and my whole goal is to make my faculty's life as easy as possible so we want to find students that are not just smart, but cooperative and emotionally intelligent, that aren't going to be all excuses, that are going to be prepared for class, and are able to handle what comes their way. (Participant D)

Participant E discussed an experience with a student who was accepted into the program with a medical disorder which caused malformations in the development of the digits on the student's hand. Traditional academic admissions criteria did not highlight this anomaly which, unfortunately, could hamper the student's ability to be successful in the dental hygiene program

and profession, thereby wasting her time and financial commitment to the program. “So, I’m thinking how does this student get through our administration and admissions and our fine motor? Where was the disconnect [with admissions]? What your exam is, this dexterity exam would have caught that” (Participant E).

Several of the research participants commented on the importance of implementing DEs as a tool to discover the dexterous ability of applicants and for student self-assessment (Participants A, D, E, and H). Participant A further discussed an additional benefit of implementing DEs, which is, providing applicants with a glimpse into what part of their daily role is within the profession.

They need to know that you’re going to be looking in a mouth that’s very little, it’s dark, you have little instruments in there and this is what you’re going to be doing day in and day out, and it kind of sets the scene for those potential students before they’re accepted to kind of say, okay, this is a glimpse of what I’m going to be doing, and I think that probably helps a little bit especially if they haven’t worked in dentistry before.

(Participant A)

If students perform poorly on the DE or find the manipulation of dental instruments is extremely challenging, they may realize dental hygiene is not the right fit for them before making a time and financial commitment. “We have students...they do all the pre-requisites, all the sciences involving anatomy and everything, come through, interview...get into the program and they’re like, oh, this isn’t really what I want to do so then they drop” (Participant A). This scenario is one that impacts program attrition rates. Implementing a DE can provide a glimpse into the

dental hygiene profession for student applicants yielding benefits for both dental hygiene programs and prospective students.

Ease of use to administer. Several participants reported DEs were not imposing on their program or faculty's regarding their use. Participants A and D, who use DEs as part of their pre-admission criteria, stated DEs are given in conjunction with the students' preadmission interviews. As a result, there is no additional scheduling or time allocation that needs to be made for the faculty, student applicants, or the administration of the DE as the exam itself only takes several minutes to complete. "I think because we have 10-minute intervals for those interviews, it's not really adding any more time to that, it's [the DE] just part of the interview so it's nothing that the faculty have to do outside of what they're already doing" (Participant A). Participant H does not administer the DEs on-site rather, they administer the DE at a testing facility. When asked about the positive impacts of implementing DEs, Participant H stated, "Since we don't have to administer any of it, we don't have any impact on us so just student wide, we would not run without it" (Participant H). Not having to administer the exam on-site is positive as there is no impact on faculty, time, and cost to the department.

Reduction in attrition rates. Attrition is, "the unit of measurement used to determine the rate of dropout of students who do not return for or during their first and second year of college" (Stein, 2018, para. 2). Participant H reported that using DEs has been advantageous in reducing attrition rates in her program. Identifying students with low dexterous ability provides academic institutions with the option to not accept a student into the program or to offer additional faculty support and clinical remediation upon acceptance. Participant H discussed increasing program benchmarks for student spatial and dexterity testing because of previous high program attrition rates. Performing an internal retrospective analysis of the past seven years of

the dental hygiene students in the program, data revealed that the high attrition rates were due to a lack of dexterity and spatial ability.

We had a grad student here who was our administrative assistant and I said, I know why they're failing out, it's spatial...but I can't prove it. She had to do a project and went back in the archives for seven years, came back with the data and she said, it is spatial.

(Participant H)

Participant H further commented she feels the implementation of DEs as a pre-admission requirement helps give an idea as to the dexterity level of potential students coming into the program. "It keeps out the students that [are weak], we already have an attrition rate so I can't have more. [When] they did...take it [dexterity/spatial exam] and there were no benchmarks we lost students to clinical failures," and recognizing the problem, "we bumped up the benchmarks for spatial and dexterity" (Participant H). Participant F, who does not use DEs stated the following:

It's definitely something that I do want to look into because we feel that if we could implement a dexterity exam it would help us have better attrition rates...we have our highest rate of attrition in the first year pre-clinic and that is due to limited dexterity and instrumentation. (Participant F)

Moore et al. (2016) found one of the three most common factors that played a role in student attrition in dental hygiene programs was an inadequate or a lack of clinical skills (p. 382). Implementing a DE as a preadmission requirement can identify the dexterity level of potential students. Dexterous ability directly relates to the aptitude of clinical skills (Holmes et al., as cited in Sanderson & Lorentzen, 2015). Selecting students who are most likely to

complete the program successfully is a goal of dental hygiene programs due to the admissions standards mandated by CODA. Program completion rates, success on state and national board examinations, and student retention and attrition rates are of vital importance because all are used as evaluative tools to assess individual program effectiveness for accreditation (Sanderson, 2014).

Theme 4: Student Applicants Have a Lower Level of Dexterous Ability

An additional emergent theme was the perception that current student applicants are coming into the program with less dexterous ability when compared to student applicants from decades earlier due to differences in or a lack of experiences with dexterity in the formative years and throughout life. According to ADEA (2019), activities such as, but not limited to, writing, drawing, knitting, and sewing, help build and refine manual dexterity skills. As younger generations are performing fewer manual tasks requiring dexterity (i.e. needlepoint, carpentry, and mechanical skills) and spending more time using technology, fine motor skills, and dexterous ability may be lacking.

Participant H stated when attending the program director's meeting for her state, one of the three frequently discussed problems is students coming into dental hygiene programs with less dexterity. "There is a timeline to learn dexterity and if they're too low, they're just not going to be able to pick it up...so spatial is a problem" (Participant H). All individuals will have different experiences with the environment from birth to adulthood which yields a multitude of diverse encounters with dexterous tasks. Based on unique experiences the level of dexterity can vary considerably from person to person. Some experiences with dexterous tasks that help refine manual dexterity skills include, but are not limited to, knitting, sewing, needlepoint, writing

(penmanship), drawing, painting, manual labor (mechanical work with tools), and playing a musical instrument (ADEA, 2019a).

Participant F stated, “We talk to them [the students] from the very beginning about how they are holding their pen when we see them writing at the information session and really...they don’t really teach penmanship anymore in elementary school,” implying that because the skill of penmanship which builds upon manual dexterity is no longer taught, it could potentially impact the dexterous skill level of incoming students. Participant G discussed in her semi-structured interview that when talking to students in preclinic they have casual conversations that center around the students’ previous dexterous experiences such as, “did you play the piano, did you knit, did you crochet, things like that...I’m a knitter, I was knitting since I was eight so I have those fine motor skills” (Participant G). When students are struggling clinically with manual dexterity, inquiring about previous experiences with dexterity can offer additional insight as to future potential skill acquisition. Participant B stated that implementing DEs into her program would be beneficial because “new generations hands are working so differently because of the day to day activities and hobbies [they have and are taking part in].”

Theme 5: Validity and Reliability

The concept of validity focuses on whether the instrument or tool measures what it is intended to measure (Taherdoost, 2016, p. 28). The concept of reliability deals with reproducibility or whether an instrument or tool can provide a stable consistent result when repeated or reproduced (Taherdoost, 2016, p. 33). Participants were asked to discuss their perceptions and experiences regarding whether DEs were a valid and reliable tool to assess the fine motor abilities of student applicants. Gaining participants' perceptions of the validity and reliability of DEs are important in determining why they are or are not being used as a

preadmission criterion. Results were mixed with some participants indicating they believed DEs were both valid and reliable, while others expressed uncertainty due to a lack of evidentiary data.

Positive pronouncements of validity and reliability. Participant A currently uses DEs in her program as a preadmission requirement and has for the past three years. When asked her thoughts whether DEs were a valid and reliable tool to assess the fine motor skills of student applicants, Participant A stated the following:

I would be more toward yes but not a definite yes...some applicants have never picked up a dental instrument and don't know how to hold it...they're just listening to the directions and hopefully following as best they can...I think it's reliable in the sense of you get an idea and they do as well, to know what they're going to be doing...I wouldn't say it's a hindrance by any means.

Participant B does not use DEs in her program as a preadmission requirement but indicated based on her existing knowledge it is a valid and reliable tool to assess and identify students' skill set early on. Furthermore, it allows students who are identified as having low dexterity to be placed into a skills refresher or remediation to improve their skill.

I think that they would be valuable because you do see students who struggle because of the dexterity and the grasp so I think...you would really be able to utilize that data...even after they were accepted into the program so that you would know who...maybe needs a little bit more remediation or a little bit more hands-on instruction. So, knowing if [they] are good or bad or in the middle, I think that you can kind of start off with the skill set before just diving right into dental hygiene. (Participant B)

Participant G does not use DEs in her program as a preadmission requirement however, her experiences with dexterity as an essential function of the dental hygiene profession have led her to consider DEs a valid and reliable instrument. She speaks to her students in preclinic about their individual experiences with dexterity to gain additional information about their potential skill level.

When we're talking there in preclinic...I'm a knitter, you know I was knitting since I was eight, so I have those fine motor skills. [We will ask] well did you play the piano, did you knit, did you crochet, things like that. I'm just in conversation...trying to gain information from them [about their experiences with dexterity]. (Participant G)

Participant H has been using DEs as a preadmission criterion for the past 16 years. When asked about her perceptions regarding whether she feels DEs are a valid and reliable tool Participant H stated,

Yes, it's the best thing that we have right now. So, it's not perfect but it is a benchmark and it does keep out the ones who really have no skills and those are what impact our program from moving forward.

Uncertainty surrounding validity and reliability. Participant C does not use DEs in her program as a preadmission requirement and stated the following regarding the validity and reliability of DEs as a preadmission requirement:

I think that we probably have to study a whole lot more on the validity of whether it really measures their ability to do what they are intended to do, so what does the data say on that? I think that we would study that a lot more [to determine] does the exam really

identify a student's ability later on in clinic. [Right now] I feel like I don't have enough information.

Participant D has been using DEs as a preadmission requirement for the past three years however, the first two years the DE was used as a method of student assessment only and not scored. This past year is the first where the DE was calibrated and scored. Participant D stated "I can speak more to the validity than the reliability at this point. Anecdotally, my gut tells me it's valid, but I don't have any numbers [yet], and reliability will come with running numbers" (Participant D). Participant E does not use DEs as a preadmission requirement in her program and stated the following when asked about the validity and reliability of DEs,

Honestly, I can't say because I know there's multiple out there that I looked at. I think it's an adjunctive, so I'd like to say it's a great support, but not the final decision. It gives another piece of the puzzle in the evaluation if that candidate is going to be successful in the program.

Participant F does not use DEs as a preadmission requirement in her program, however, stated, "I am not familiar with specific dexterity exams however, based on what we've previously talked about I feel that there could be validity to it" (Participant F). Findings regarding validity and reliability are mixed. While 50% of participants spoke in favor of the validity and reliability of DEs the remaining 50% expressed feelings of ambiguity. While most participants feel there is value in implementing a DE as a preadmission criterion, a lack of knowledge, a lack of use, and/or a lack of evidentiary data has caused uncertainty surrounding its validity and reliability.

Secondary Findings

Additional findings indirectly related to themes identified were discovered while conducting semi-structured interviews with research participants. While discussing the use of DEs as a preadmission criterion, participants that used DEs shared the types and methods of DEs they are implementing in their respective programs. In addition, many participants shared and elaborated upon the preadmission criteria currently used in their programs. In addition, two participants discussed the development and use of an introduction to dentistry course used as a preadmission criterion that prospective students complete prior to admission into the program.

Types of DEs used by dental hygiene programs. The participants of the three programs currently using DEs as a preadmission criterion (Participants A, D, and H) discussed experiences with their use and elaborated on the type of DE utilized at their respective institution. Each participant reported using a different type of DE. Participant A uses a typodont with a dot placed on the lingual surface of tooth #30. Students are asked to place a probe into the gingiva on the red dot using the mirror (indirect vision) without leaning and looking directly. Students are then graded on an accompanying rubric. Participant D uses a mirror tracer as a DE. Applicants are required to trace a mirrored star pattern onto paper. The paper is shielded from direct view of the paper or the hands of the test taker. The goal is to stay within the lines of the two imposed stars which are parallel to each other and approximately ¼ inch apart; errors are calculated by touches or crossing over the lines (Lafayette Instruments, 2004, p. 2). Participant H was unsure of the name of the DE her program is using however, she reported, “We use [the DE with] the pins.” Several DEs use pins including the Purdue Pegboard Test, Grooved Pegboard Test, Crawford Small Parts Dexterity Test, and the O’Conner Finger and Tweezer Test yielding a variety of options her program could be using.

One of the concerns discussed by several of the participants not using DEs as a preadmission criterion centered around the logistics of having to provide DEs for each applicant accepted to the program and the strain this could cause on the department (faculty, time, monies, etc.). Participants A and D both administer the DEs in conjunction with applicant interviews resulting in no additional time needing to be scheduled for the DE, rectifying the time concern and monetary cost to the institution. In addition, interviews and DEs are not granted for all student applicants petitioning for admittance into the program. Both participants have minimum requirements that potential applicants must meet before being considered for an interview and DE assessment.

They have to have a minimum of a 2.7 to be even eligible to come into the program for an interview...they have so many prerequisites completed and things like that. They get a score for all those things. They're scored on their interview and then those two are combined and then that gives us our total score. (Participant A)

Participant D also has program requirements that must be met prior to applicants being scheduled and interview and a DE assessment. A grid is used that allots points for select criterion (Composite ACT scores, science GPA, overall GPA, and a previous degree to name a few). "I add that sheet ... and that's how we put them [applicants] in order and that's how they come in to interview, and again, it's all points, it is the 48 to 50 [applicants with] the lowest points" (Participant D). Using a grid and/or point system to narrow down the applicant pool allows the actual number of applicants needing to be administered a DE more manageable. Participant H uses a testing center to administer the DE of her student applicants providing additional resolution for what has been perceived to be a daunting task by other research participants and listed as an obstacle to use and implementation.

Varying preadmission criteria. Findings suggest each dental hygiene program uses varying criteria as part of the preadmission process. Various preadmission criteria discussed by the research participants included, but is not limited to, a variety of academic criteria such as ACT and TEAS exam scores, prerequisite college course scores, overall GPA, having a minimum GPA for entrance into the program, candidate interviews, shadowing a dental hygienist for a determined number of hours, previous dental assisting experience, writing an essay, emotional intelligence examinations, DEs, taking an introductory dental/dental hygiene course, having a previous college degree, and residency where the institution is located. Some criteria, such as having a previous college degree and residency where the institution is located, are not mandatory but can earn a potential applicant extra points toward their overall admissions score. See Table 5 for a general overview of the preadmission criteria used by each research participant in their respective programs.

Introduction to dentistry/dental hygiene course. Participants B and H both have an introductory course to dentistry/dental hygiene as a preadmission criterion for incoming students. In both programs (Participant B and Participant H), students are given additional points toward their admissions score for completing the introductory course. The introductory course offered at Participant B's institution provides fundamental information about dental and dental hygiene practices such as terminology, processes, and basic tenets of the profession. Similarly, Participant H's dental hygiene program has students complete a dental hygiene introductory course. The course is given asynchronously, involves field observations, discussion boards, a paper using APA formatting, and assessments such as quizzes. Participant H discussed several benefits of implementing this introductory course, it introduces the rigor that accompanies dental hygiene programs, gives potential students an idea of the demands of the program, and fosters

students a lesson in the importance of time management. As Participant H explained, “Our attrition rate has really been awful for the last five years.” As a result, she took an introspective look at the introductory course and revisions were made to reflect a higher level of learning that replicates the true rigor of the program.

Table 5

Preadmission Criteria Used by Participants in the Dental Hygiene Admissions Process

Assigned Participant Letter	A	B	C	D	E	F	G	H
Academic Criteria	x	x	x	x	x	x	x	x
Prerequisite courses	x	x	x	x	x	x	x	x
Interviews	x			x				
Shadowing		x	x	x		x	x	x
Essay			x	x				
Previous Dental Experience		x				x		
Introductory Dental or Dental Hygiene Course		x						x
Manual Dexterity Exam	x			x				x
Emotional Intelligence Exam				x				
Previous college degree				x		x		

Note: Academic criteria can include overall GPA, SAT scores, ACT scores, TEAS exam scores, Math, English, and Science course scores, and a minimum GPA for entrance into the program.

We’ve changed it the last two years [bumping up the criteria]. I asked [the instructor] to do a survey this year [asking students]...was this class beneficial in defining if you would like to go forward with dental hygiene or not...and 12 of them out of 40 said, ‘I’m glad I took this class, I so thought I wanted to be a dental hygienist but this isn’t for me’. So we

tried to introduce the rigor...we had seven quit our first semester [stating] ‘this is just too hard’...so we’re hoping that this incoming class will reflect the higher rigor and understand what they are in for. (Participant H)

Participant H further explained, “I just don’t think anybody can tell you how difficult dental hygiene school is” implying that taking this introductory course introduces the intensity that accompanies dental hygiene programs providing potential student applicants with a preview of the requirements of the program. Modifying and restructuring the introductory course to reflect a higher level of rigor also provided students with an introduction and experience to the importance of time management which is an essential skill once accepted into a dental hygiene program due to its intensive nature.

I give them a week of time and how are you going to divide this [workload] up? You still have to eat, do laundry...the essentials. How are you going to fit in all these hours of studying and clinical practice that you need to do? They have better students because their time is more managed (Participant H).

The use of an introduction course to dentistry or dental hygiene as a preadmission criterion has had several benefits at the dental hygiene program of Participant B and Participant H. Prospective students are introduced to the basic tenets of dental hygiene practice and the rigors that accompany the intensiveness of the program. Providing the experience of a first look into the profession, students get a true sense of the roles and responsibilities of dental hygiene practice and the demands that accompany it. Students have the benefit of realizing dental hygiene may not be the occupation they want to pursue and recognizing this enables coveted and limited enrollment seats to remain open for other prospective students.

Chapter 4 Summary

Chapter 4 discussed the data collected from the semi-structured interviews conducted with eight dental hygiene department chairperson participants in the U.S. Using a qualitative phenomenological design with deep interviewing techniques allowed for an examination of the inner consciousness of individuals, their experiences, and how those experiences with DEs as a preadmission criterion were perceived and regarded. Chapter 4 included a description of the sample, demographic data, research methodology and data analysis, a summary of the findings, and the study results. Five overarching themes were identified: knowledge, obstacles with implementation, positive impacts of implementation, student applicants have a lower level of dexterous ability, and validity and reliability. Conclusions drawn from the results and recommendations for future research will be addressed in Chapter 5.

Chapter 5: Discussion and Conclusion

Research indicates DEs are a valid and reliable tool to assess the fine motor skills of dental school applicants (Cleghorn et al., 2018; Kothe et al, 2014; Lugassy et al., 2018; Schwibbe et al.; 2016, Segura et al., 2018). The literature supports the effectiveness of DEs in identifying students with weak or low dexterous ability (Schwibbe et al., 2016; Segura et al, 2018; Sullivan et al., 2014). However, research is sparse regarding the use of DEs as a preadmission criterion in dental hygiene programs with recent research indicating only 3% of all dental hygiene programs (N > 325) in the U.S. utilize DEs as a preadmission requirement (Sullivan et al., 2014). A detailed review of the literature surrounding DEs support the context of this study and the research methods used.

The aim of this study was to identify how DEs are used as a criterion for preadmission into dental hygiene programs. Examining the lived experiences of the dental hygiene program directors allowed the researcher to gain insights as to their perceptions of DEs as a valid and reliable tool in assessing the fine motor skills of student applicants and as a contributing factor in the admissions process. Acquiring knowledge about DEs and identifying considerations and components for successful implementation can provide direction and guidance for dental hygiene programs. The study also provides important implications in dental hygiene education, as sharing the attitudes and experiences of research participants will bring new information and knowledge to dental hygiene education and the preadmission process. Chapter 5 will summarize the study findings in relation to the research questions and sub-questions. Chapter 5 will further discuss the results of the study in relation to the literature, the limitations of the study, the implications of the results on policy, practice, and theory, recommendations for future research, and present conclusions drawn from the research study.

Summary of Results

Phenomenology was the qualitative design and framework used for this research study as the primary purpose was to understand the experiences of program directors at accredited dental hygiene programs surrounding the use of DEs as criteria for preadmission of potential student applicants. A phenomenological approach was deemed appropriate as the researcher sought to understand how a specific group of individuals experienced a certain phenomenon surrounding the use of DEs. Using semi-structured interviews allowed for deep interviewing techniques which lent itself to uncovering rich data about the experiences and perspectives of research participants. To address the aim of this study, the following research question and sub-questions were developed:

Research Question

1. How are dexterity examinations used as a criterion for preadmission into accredited dental hygiene programs?

Research Sub Questions

1. What is the perception of program directors regarding the validity and reliability of dexterity examinations as a preadmission requirement?
2. What is the perception of program directors regarding the feasibility and use of implementing dexterity examinations in an accredited dental hygiene program?

Eight participants of varying geographic locations across the U.S. were selected using purposeful sampling to ensure that the research pool contained both, programs that use and do not use, DEs as a preadmission criterion. Semi-structured interviews were used to collect data as this method allowed for participants to discuss their individual lived experiences from a personal

point of view. After a thematic analysis and coding of the data collected, the following themes emerged surrounding the use of DEs as a preadmission criterion: participants knowledge of DEs, obstacles with implementation, positive impacts of implementation, student applicants have a lower level of dexterous ability, and perceived validity and reliability as an evaluative tool to assess the fine motor skills of applicants.

Discussion of Results

The dental hygiene curriculum is content-intensive and time-consuming, requiring students to have mental acuity and fine motor skills to meet the clinical demands of the program and profession upon graduation. Dental hygiene programs strive to accept students who are adept, in both academics and dexterous skill, can manage the rigors of the program, and complete it successfully. Accepting student applicants who are lacking in either mental acuity or manual dexterity can compromise program completion rates, success on state and national board examinations, and student retention and attrition rates. Academic scores, while important, have been ineffective as an indicator of an applicant's ability to succeed clinically or to predict clinical performance (Dabaliz et al., 2017; Lugassy et al., 2018; Rudy et al., 2017). Dental programs, which parallel dental hygiene programs, have a psychomotor or dexterity exam built into the DAT which is a standardized test required to be taken by dental school applicants. According to the ADA (2020), "The DAT Program is administered to understand the skill levels of applicants seeking admission to dental school. Dental schools use this information to inform admissions decisions" (p.4). With recent reports indicating only 3% of all dental hygiene programs (N > 325) in the U.S. utilize DEs as a preadmission requirement (Sullivan et al., 2014), the researcher sought to identify how DEs are being used and what obstacles or challenges may be preventing their use.

At the completion of the semi-structured interviews, the participants responses were uploaded to NVivo transcription software, reviewed for accuracy, and transcribed. Participant transcriptions were reviewed and coded using a code re-code strategy. After coding the data, five themes emerged: participants knowledge of DEs, obstacles with implementation, positive impacts of implementation, student candidates have a lower level of dexterous ability, and perceived validity and reliability of DEs.

Knowledge of Dexterity Examinations

The first theme, knowledge of DEs, centered around participants existing knowledge of a DE. Most participants reported some degree of knowledge of DEs in that they could describe what a DE is and what it is used for. Participants who do not use DEs as a preadmission criterion had a general knowledge of DEs but were lacking in details and intricacies of a DE. The research finding of having general knowledge but lacking extensive knowledge of DEs could be due to the overall lack of use of DEs in accredited dental hygiene programs nationwide (Sullivan et al., 2014). Without independent research and DE utilization, comprehensive knowledge of DEs could be lacking.

Obstacles with Implementation

The second theme, obstacles with implementation, focused on identifying factors that impeded the current or future use of DEs as a preadmission requirement. Participants discussed several obstacles surrounding their experiences with DE implementation. This led to the development of four sub-themes: repetitive use of the same DE, lack of support from admissions, quantity of candidates to screen, and historical reasons.

Repetitive use of the same DE. There are a multitude of different types of DEs that can be used as a preadmission criterion, depending on the specific skill requiring assessment and the need of the institutional program. For programs that use DE as a preadmission criterion, one challenge has been the need to come up with something different and relevant to assess the dexterity of student applicants. When the same DE is consecutively used year after year, details of the examination may be communicated to incoming student applicants. It could be suggested, having prior knowledge of the DE can lead to potential skill practice. This can skew results and potentially impact the validity and reliability of the exam. To avoid bias in the test and eliminate confounding variables such as skill practice, programs should consider alternating the type of DE used each year.

Admissions. Several participants who do not use DEs as a preadmission criterion reported that admissions department personnel at their respective institutions are an obstacle with implementation. A concern of college admissions department personnel, as discussed by participants, centered around bias and subjectivity. Admissions department personnel are concerned with criteria remaining objective and not exclusive to prospective student applicants. It could be suggested due to a lack of knowledge surrounding DEs by admissions department personnel, there is a misconception and ambiguity surrounding their use, specifically as an objective instrument to evaluate the dexterous ability of student applicants.

In addition, the way in which DEs are weighted in the preadmission process is at the discretion of each individual program. The use of DEs as a preadmission criterion does not need to be the sole deciding factor for entrance into a dental hygiene program. Their use can alert programs and department faculty to potential issues and serve as an adjunct in admissions decisions. DEs have been proven effective in the literature as identifying the dexterous ability of

applicants and matriculated students, which warrants consideration for use in the preadmission process of dental hygiene programs (Cleghorn, 2018; Schwibbe et al., 2016; Segura et al., 2018; Sullivan et al., 2014). The ability to identify a student applicant with low dexterous ability allows programs to make the decision to remediate the student with additional clinical support or deny applicant admission, both of which can improve program retention rates.

Quantity of applicants to screen. Several participants who do not use DEs in their programs reported the applicant pool each academic year as immense leading some to question how they would accomplish the administration of DEs to all student applicants, and what type of impact this would have on time, faculty, and the department as a whole. Two programs administer the DE in conjunction with student interviews while another uses an off-site testing center. It appears that incorporating the DE into another component of the preadmission process (applicant interviews) or using a testing center to administer the examination has been a means to remove the obstacle of time and faculty needed for DE administration.

In addition, interviews and DEs are not granted for all student applicants petitioning for admittance into the program. Some participants reported the use of minimum requirements potential applicants must meet before consideration of an interview and DE assessment is granted. Some of these requirements include minimum GPA, prerequisite courses, and composite ACT scores. Using a grid and/or point system of additional admission requirements, student applicants are selected for an interview and DE based on those with the highest score. This produces a more manageable number of applicants who are administered a DE. One participant reported the use of a testing center to administer the DE of student applicants. Administering the DE at a testing center provides a solution to the perceived obstacle to the use and implementation voiced by several participants. Results of this study suggest narrowing the

applicant pool and administering the DE, in conjunction with applicant interviews, or at a testing center, has been a successful way to mitigate the identified obstacle of quantity of candidates to screen.

Historical reasons. Several research participants discussed historical reasons as an additional obstacle with implementation of DEs. Participants explained DEs have never been used as a preadmission criterion in the history of their dental hygiene programs. It could be suggested if a program is running successfully without the use of DEs as a preadmission requirement, there is not a perceived need to change program admissions protocols. In addition, several participants acknowledged a lack of knowledge regarding DEs which could further impede the acceptance and use of DEs as a preadmission criterion.

Positive Impacts of Implementation

Theme Three, positive impacts of implementation, focused on the positive impacts using DEs has had on and within the department. Participants discussed several positive impacts of implementing DEs which lead to the development of three sub-themes. These sub-themes include: the ability to identify the dexterous ability of potential student candidates, ease of use to administer, and a reduction in attrition rates.

Identifying the dexterous ability of student applicants. Several participants discussed a positive impact of implementation to include the ability of a DE to identify the dexterous ability of student applicants. Having a tool that can assess the manual dexterity of applicants can aide programs in several ways: selecting students who have the greatest propensity to succeed, remediating students who are identified as having low dexterous ability early in the program, or denying admission to students who lack the dexterity to complete the program successfully. If

student applicants have low dexterous skills, there could be negative effects to both the applicant and the academic institution. Such negative effects can include pre-clinic and clinical course failures, program dismissal, student stress, student loss of time and monies, and an increase in attrition rates at both the program and institutional level. Results of this study suggest there are several advantages to the use and administration of DEs as a preadmission requirement. Participants communicated the main advantage to be the ability to identify student applicants most apt to succeed in a dental hygiene program.

Ease of use to administer. Several participants reported DEs were not taxing on their program or department faculty. Some programs provide DEs in conjunction with the applicant interviews. As the DE only takes several minutes to complete, there is no additional time demand or stress placed on faculty. One institution administers DEs at an off-site testing center removing the onus from faculty and cost to the department. It could be suggested because the DEs are administered in conjunction with other preadmission criteria (applicant interviews) or at an off-site facility, there is minimal to no negative impact on faculty, time, and cost to the department.

Reduction in attrition rates. Several participants expressed a positive attribute of DEs to include assisting in the reduction of program attrition rates. DE results are used as an additional piece of assessment in determining the acceptance of an applicant. Their use can identify students who lack the clinical proficiency needed to succeed in a dental hygiene program, and can assist in the admission selection process, denying weak applicants' entrance to the program. Preclinical course failures and a lack of clinical skills are two of the top four identified factors contributing to attrition (Moore et al., 2016). The results of this study suggest the implementation of DEs as a preadmission criterion allows for the identification of the

dexterous ability of student applicants. This permits faculty to make a more comprehensive and informed decision as to the aptitude and manual ability of the applicant, and their ability to succeed in a dental hygiene program.

Student Applicants Have a Lower Level of Dexterity

Theme Four, student applicants have a lower level of dexterous ability, focuses on the level of dexterity student applicants come into the program with, both innate and learned. Some participants explained, due to the technology driven time that we live in, manual tasks are less experienced, less practiced, and students are coming into programs with lower levels of dexterous ability. Tasks and activities have progressed from sewing, turning a screwdriver, and writing in cursive (performing manual tasks), to typing on computers and laptops, and looking, listening, and watching on electronic devices. Dexterity is developed in the formative years and continues to develop throughout life with the unique experiences each individual has with dexterous tasks. It could be suggested because individuals have less experiences with dexterous tasks throughout their lifetime (i.e. sewing, painting, penmanship, mechanical work), dexterity is not being formed and developed to an adequate level needed for the practice of dental hygiene.

Validity and Reliability

Theme Five, validity and reliability, focuses on the perceptions of participants regarding the validity and reliability of DEs as a preadmission criterion. Participants had mixed views. Some participants expressed agreement of the validity and reliability of DEs while others expressed uncertainty. While none of the participants indicated DEs are not a valid and reliable tool, the study results suggest the ambiguity surrounding the validity and reliability of DEs could be due to of a lack of knowledge, a lack of use, and a lack of evidence-based research. Without

firsthand experience with DEs and observing the impact of DEs on participants respective programs, it may be difficult to judge the validity and reliability of DEs.

Discussion of the Results in Relation to the Literature

Few studies have focused on the use of DEs as a preadmission criterion in dental hygiene programs. Moreover, there are no qualitative phenomenological research studies to date which attempted to gain the insights and perceptions of dental hygiene department chairs surrounding the use of DEs as a preadmission criterion. Uncovering rich data using semi-structured interviews allowed the participants to share their thoughts, experiences, and perceptions of the use of DEs, obstacles and positive impacts of implementation, and the validity and reliability of this assessment tool.

Ability of Dexterity Examinations to Identify the Dexterous Ability of Student Applicants

Several research participants discussed the ability of a DE to identify the dexterous abilities of student applicants. The results of this study are supported by previous research discussed in the literature. Neves & Garcia (2018) indicated DEs are beneficial in identifying students “who will experience difficulty in pre-clinical training” (p. 3). Segura et al. (2018) performed a study using a DE to identify and assess the fine motor skills of dental students. Results revealed the ability of the DE to identify the psychomotor skill levels of students. Similarly, Cleghorn et al. (2018) performed a 6-year study of dental students to determine if preadmission DE scores correlated to a student’s skill set in preclinical courses. Results showed students who scored low on the DE also displayed weak dexterous skills in preclinic, supporting the ability of a DE to identify the dexterous ability of student applicants. Also, Kothe et al. (2014) conducted a study comparing the HAM-Man DE scores and high school GPA to preclinical performance. Data revealed the results of the HAM-Man had a greater impact on

preclinical performance when compared to GPA which had minimal influence on performance. The use of DEs to identify the dexterous ability of student applicants is further supported by the findings in this current study.

Reduction in Attrition Rates

Dexterity examinations as a tool to aide in the reduction of attrition rates was an additional finding of this study. Because the DE can identify the dexterous ability of students, it provides faculty with a more comprehensive assessment of the applicant providing additional knowledge with which to make an informed decision about applicant selection. It could be suggested the reduction in attrition rates by some of the programs who are using DEs is a result of their use as a preadmission criterion.

The findings of this study align with those of Sanderson (2014), Moore et al. (2016), and Whisenhunt (as cited in Evans et al., 2011). Sanderson (2014) performed a study examining preadmission variables that correlate with student retention. Noncognitive variables, which include DEs, showed a trend toward reduced retention rates. Similarly, Moore et al. (2016) performed a study to determine the impact of selective versus nonselective admissions criteria in dental hygiene programs. The top four identified factors contributing to attrition included academic standards, personal issues, clinical skills, and preclinical course failures. The study by Moore et al. (2016) also indicated at some institutions, program funding and evaluation are based on student retention and program completion rates causing loss of financial support for the program and reduced status and/or reputation of program effectiveness.

A study by Whisenhunt (as cited in Evans et al., 2011), discussed the findings of attrition rates in a single dental hygiene program over a three-year period (p. 7). The results of the study

revealed 8% of students were dismissed during the first year of the program due to inadequate clinical skills followed by 33.3% the second year and 25% the third year. High attrition rates were directly correlated to students who were unable to perform clinically or had weak fine motor skills. It could be suggested, implementing DEs allows programs to make a more comprehensive and informed decision regarding the aptitude of the student applicant and their ability to be successful in a dental hygiene program. This can lead to less preclinical course failures and a decline in attrition rates.

Validity and Reliability of Dexterity Examinations

Study results regarding the validity and reliability of DEs were mixed with some participants indicating DEs were both valid and reliable, and others expressing uncertainty due to a lack of evidence-based data. The findings in the literature indicate DEs are a valid and reliable tool to assess dexterous ability of candidates. González Sánchez (2016) discussed the Purdue Pegboard Test and the Minnesota Manual Dexterity Test to be two types of DEs proven in the literature as a valid and reliable tool to assess the manual dexterity of applicants (pp. 38-39). According to González Sánchez (2016),

It [the PPT] has been ranked by systematic reviews as one of the top three assessments of dexterity for health care professionals, due to its reliability and validity as well as its fewer confounding variables, such as age, gender, and handedness. (p. 38)

Segura et al. (2018) performed a pilot study to identify the ability of the DePS as an instrument to identify and assess fine motor skills of first-year dental students (N = 237). Results found the DePS to be a valid instrument to assess the psychomotor skills of students. Similarly, studies by Cleghorn et al. (2018), Kothe et al. (2014), Lugassy et al. (2018), and Sullivan et al. (2014) all showed the ability of DEs as an evaluative tool to assess the clinical aptitude of applicants.

The findings in this study are somewhat inconsistent with previous results discussed in the literature. While the literature supports the validity and reliability of DEs to identify the dexterous ability of applicants, it could be suggested the findings of this study are indicative of a lack of knowledge surrounding the use of DEs. Without personal use and experience with DEs, there is a perceived lack of evidence-based data. Although there is evidence-based research to support the validity and reliability of DEs as a tool to assess dexterous ability of applicants, studies pertaining directly to the profession of dental hygiene are lacking, which may add to the confusion surrounding its validity and reliability.

Implications of the Results for Policy, Practice, and Theory

The results of this phenomenological study have implications on the policy and practice of dental hygiene. The data collected surrounding participants' experiences with DEs as a preadmission criterion in dental hygiene programs offer support and guidance for admissions policy and departmental implementation. The results also bear implications on the theory of skill acquisition and transcendental phenomenology.

Implications for Policy

The results of this study hold implications in dental hygiene policy. Three of the eight participants interviewed currently use DEs as a preadmission criterion. Of the remaining five participants, all except for one indicated they would be open to and/or consider implementing DEs as a preadmission criterion in their program due to their perceived benefit. These findings, along with the evidence-based research indicating DEs have been proven effective in identifying students with low dexterous ability, provide support to institutional admissions to approve the implementation of DEs as a preadmission criterion in dental hygiene programs (Schwibbe et al., 2016; Segura et al., 2018; Sullivan et al., 2014).

Implications for Practice

The results of this study provide guidance for other accredited dental hygiene programs. Information gained from participants about the use of DEs provide insight to obstacles faced with implementation and ways in which those obstacles can be mitigated. A primary obstacle surrounding implementation of DEs identified in this study, is a large applicant pool to screen. Implementing DEs as a preadmission criterion, however, does not warrant its use for each applicant applying to the program. If implemented, additional preadmission criteria and standards can be included to narrow the applicant pool tailored to the needs of the individual program. Thereby, only the top applicants would be chosen to complete a DE.

Results of this study offer guidance as to how DEs would be implemented if used. Administering the examination at a testing center or in conjunction with additional preadmission assessments (applicant interviews) alleviates time and any financial burden to the department. These steps pose suggestions for other dental hygiene programs nationally, providing solutions to some of the obstacles and concerns expressed by research participants.

An additional concern of dental hygiene program directors has been attrition rates requiring a need to select applicants who are most apt to succeed in the program. The implementation of a DE as a preadmission criterion would allow examiners to assess the fine motor skills of potential applicants identifying students with weak dexterous skills. Students identified with weak dexterous skills can be placed in skill remediation and/or given dexterity strengthening exercises that focus on honing and developing fine motor skills. Students identified as having dexterous skills that are deemed too low, compromising their success and ability to complete the program, can be denied admission. This saves time and financial

commitments on the part of the student, while improving program retention and completion rates of the program.

Implications for Theory

Skill Acquisition Theory. The basic principle of the Skill Acquisition Theory is the acquisition of skill is a form of knowledge attainment, where skilled behaviors are learned, practiced, and eventually become automatic as learners move through the three stages of this theory: cognitive, associative, and autonomous (Kee, 2019). Dexterity can be improved upon to a certain degree and is based on exposure to different experiences in an individual's lifetime. Experiences that foster dexterity include guided instruction, knowledge acquisition, and repeated skill practice. All individuals will have different and unique experiences with the environment from birth to adulthood yielding a variety of experiences with dexterous tasks which can impact dexterity levels.

The results of the research study provide support of the Skill Acquisition Theory as research participants suggest a potential cause for students to exhibit low levels of dexterity is a lack of experiences with manual tasks. For skill acquisition to become engrained in an individual, dexterous tasks must be learned and practiced. Several participants communicated concerns over student applicants not gaining sufficient experiences with dexterous tasks throughout their lifetime. Participants further discussed the negative influence they perceive this lack of experience to have on the fine motor skill of student applicants. Based on the tenets of this theory, lifetime experiences and repeated skill practice are fundamental in skill acquisition; if these are lacking, dexterous ability can be hampered. Implementing DEs as a preadmission criterion can identify the skill acquisition level of an applicant, alerting faculty as to their potential to succeed clinically in a dental hygiene program.

Transcendental phenomenology. Transcendental phenomenology is focused on the inner consciousness of individuals, one's own experiences, and how those experiences are perceived and viewed by the individual experiencing them (Smith, 2018). In this study, the researcher sought to understand the experiences of program directors at accredited dental hygiene programs surrounding the use of DEs as criteria for preadmission of potential student applicants. This study supports transcendental phenomenology as a qualitative research design. The use of semi-structured interviews and deep interviewing techniques allowed the lived experiences of the participants to be shared. Neubauer et al. (2019) emphasized the importance of phenomenology as a qualitative tool in health professions' education, as it allows a unique opportunity to gather a deeper understanding and learning from the lived experiences of other health care professionals. Research participants were able to look introspectively, self-examine, and share their experiences with DEs. The information shared by the participants focused on general knowledge surrounding DEs, obstacles with implementation, positive effects of implementation, and thoughts surrounding its validity and reliability. The data collected provided guidance and direction for other dental hygiene programs who wish to implement DEs into their program.

Recommendations for Further Research

This study focused on identifying how DEs are used as a criterion for preadmission into dental hygiene programs, any challenges and obstacles associated with their use, and determined if DEs are perceived as a valid and reliable tool to assess the fine motor skills of potential applicants. One theme identified in the research was student applicants presenting with lower levels of dexterity. Participants' perceptions of this phenomenon centered around applicants not having as many experiences with dexterity as generations before which could be contributing to

low levels of dexterity. The researcher recommends future studies examining the current manual dexterity levels of Gen Y (millennials) and Gen Z dental hygiene student applicants in relation to their previous experiences with dexterous tasks throughout their lifetime. Research in this area may uncover a relationship between low lifetime experience with dexterous tasks and low levels of dexterous ability, bringing new knowledge to dental hygiene education. Determining if a correlation exists may warrant the development of a manual skills program (hand function exercises and experiences with dexterous tasks) to aide students with the development of dexterity in preclinical courses. Research in this area would also contribute to the Skills Acquisition Theory, a form of knowledge attainment where skilled behaviors are learned, practiced, and eventually become automatic (Kee, 2019).

Due to the qualitative phenomenological nature of this study, a small sample size was used which can compromise the generalizability of study results. The researcher recommends additional exploration surrounding this topic to include additional participants to further delve into the phenomenon of DEs as a preadmission criterion. Gaining insights and perspectives as to what type of DEs are used and how they are being implemented may provide additional direction for dental hygiene programs nationally. In addition, several of the participants interviewed in this study have just begun to collect data on the validity and reliability of DEs as a preadmission criterion in their respective programs. If program data reveals DEs are a valid and reliable tool to identify the manual dexterity of applicants, leading to comprehensive criteria and acceptance of a higher skilled and more proficient student, this further supports the use of DEs as a preadmission criterion in dental hygiene programs.

Conclusion

Program completion and success rates on national and clinical board examinations are of vital importance in dental hygiene programs because program funding and evaluation are based on student retention and program completion rates, causing loss of financial support for the program and reduced status and/or reputation of program effectiveness (Moore et al., 2016). Preadmissions criteria needs to assess scholastic aptitude and have good predictability in identifying students who have the greatest potential for successful program completion (CODA, 2017). The dental hygiene curriculum is intensive, requiring students to have both, cognitive and clinic skills for the manipulation of dental instruments and comprehensive patient care. This warrants the use of an admission criteria that can identify the cognitive and clinical aptitude of students. DEs have been proven in the literature as an effective and evaluative tool to assess the clinical aptitude of student applicants (Cleghorn et al., 2018; Kothe et al., 2014; Lugassy et al., 2018; Segura et al., 2018). However, most admissions criteria are based solely on academic factors, with only 3% of dental hygiene programs using DEs as a preadmission requirement for program admissions (Sullivan et al., 2014). While cognitive assessments are important, they have poor predictability of clinical performance (Dabaliz et al., 2017; Lugassy et al., 2018; Rudy et al., 2017).

The results of this study uncovered insights and perspectives of dental hygiene program department chairs as to the use, feasibility of implementation, validity, and reliability of DEs. Results revealed several reasons precluding the use of DEs as a preadmission requirement which included: admissions policy at the institution, a large quantity of candidates to screen, and historical reasons. Participants using DEs as a preadmission requirement were able to provide guidance to other programs by communicating their methods of implementation and the positive

impacts experienced by administering DEs in their respective programs. Positive impacts included identifying the dexterous ability of applicants, ease of use to administer, and reducing program attrition rates. This study has brought new information and knowledge to the discipline of dental hygiene education and laid the foundation for future studies surrounding DEs and their ability to add additional methods of clinical assessment to current preadmission criteria.

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APPENDICIES

Appendix A - Invitation to Participate Email



Dear Colleagues,

My name is Loretta Mariano and I am a doctoral student pursuing a degree from the Doctor of Health Sciences Program at the University of Bridgeport, Connecticut. In partial fulfillment of this degree, I am requesting your participation in a survey examining *dental hygiene program directors' perceptions, experiences, and attitudes in regard to dexterity examinations as a preadmission criterion*.

The purpose of your participation in this research is multifocal: to help the researcher gain a deeper understanding of how dexterity examinations are used as a criterion for preadmission into dental hygiene programs, to uncover potential obstacles associated with dexterity examination implementation and use, and to determine if dexterity examinations are perceived as a valid and reliable assessment tool.

You were selected as a possible participant due to your position as a dental hygiene program director at an accredited entry-level associate and/or entry-level bachelor's degree dental hygiene program within the United States and your familiarity with the specific preadmission criteria required for your program. Your opinion and perspectives will provide valuable insights and a deeper understanding surrounding the topic of dexterity examination use in accredited dental hygiene programs as a preadmission requirement.

There will be no direct or monetary benefit from participating in this study. The anticipated benefit of your participation in this study is that your response will add to the limited body of research surrounding dexterity examinations and their use in dental hygiene programs. This information will provide an expansion of knowledge and potential guidance for dental hygiene education programs.

Taking part in this research study is voluntary. If you do choose to participate in this study, you can withdraw your consent and discontinue participation at any time without prejudice. There are no major risks or costs associated with being a research participant in this study.

If you have questions about the study please contact the primary researcher, Loretta Mariano, by calling 516-361-1667 or via email at lmariano@my.bridgeport.edu. You may also contact Dr. Mark Pitcher, Director of Health Sciences Inter-Professional Research, IRB Administrator at irb@bridgeport.edu.

This research has been approved by the University of Bridgeport Institutional Review Board

Follow the link below that says “begin survey now” to complete the survey.

[Begin Survey Now](#)

Thank you for your valuable contribution to this research as it is greatly appreciated.

Sincerely,

Loretta Mariano

Loretta Mariano RDH, MSDH
Doctor of Health Sciences Student
University of Bridgeport, College of Health Studies
Email: lmariano@my.bridgeport.edu
Phone: 516-361-1667

Appendix B - Demographic Survey and Informed Consent

The purpose of this research project is multifocal: to help the researcher gain a deeper understanding of how dexterity examinations are used as a criterion for preadmission into dental hygiene programs, to uncover potential obstacles associated with dexterity examination use and implementation, and to determine the perceptions of dexterity examinations as a valid and reliable assessment tool.

This is a research project being conducted by Loretta Mariano RDH, MSDH, doctoral student at the University of Bridgeport. You are invited to participate in this research project because of your position as a dental hygiene department chair, program director, or dean at an accredited dental hygiene program within the United States and your familiarity with the specific preadmission criteria required for your program's admission. Your opinion and perspectives will provide valuable insights and a deeper understanding surrounding the topic of dexterity examination use as a preadmission requirement in accredited dental hygiene programs.

The procedure involves completing an online survey that will take approximately 10 minutes and asks your interest in participating in a follow-up interview to discuss your thoughts on dexterity examinations as a preadmission criterion in dental hygiene programs. If you agree to an interview, you will be asked for your name, your email address and/or phone number as a means to contact you to schedule an interview, however, your name, email address, phone number and/or program will not be part of the final report to ensure anonymity. The survey questions will ask demographic information, if your programs use of dexterity examinations as part of the admission process, and if you would be interested in participating in a follow-up interview so that the researcher can gain a deeper understanding surrounding the topic of dexterity examination use in accredited dental hygiene programs.

The information collected in this study will be kept anonymous in the final report. All data is stored in a password protected electronic format. To help protect your confidentiality, the final report will not contain information that will personally identify you. The only identifying marker used in the study will be for demographic purposes and will be divide participant location into four broad regional geographical location categories which will include: the Northeast, the Midwest, the South, and the West. The results of this study will be used for scholarly purposes only which includes publication in professional journals and presentation at professional conferences. No reference will be made in oral or written reports that could link you to the study. In addition, the results of this study and may be shared with University of Bridgeport representatives.

Your participation in this research study is voluntary. You may choose not to participate. If you decide to participate in this research survey, you may withdraw at any time. If you decide not to participate in this study or if you withdraw from participating at any time, you will not be penalized.

After completing the survey, should you agree to an interview, each participant will be assigned a letter to be used in the data collection process to avoid linking responses to participants. No personal identifiers such as individual participant name or the name of the institutional employer will be used in any reports or publications resulting from the study. The only identifying marker used in the study will be for demographic purposes and will be divided into four broad regional geographical location categories which will include: the Northeast, the Midwest, the South, and the West.

The interview process will involve a one-on-one interview with the principal investigator either face-to-face, via telephone, Zoom, or Skype. A series of questions will be asked of you that pertain to dexterity examinations as a tool to assess the dexterous ability of potential candidates of a dental hygiene program. There are no right or wrong answers as your responses are based on your personal lived experiences and viewpoints. The interview should take between 30-45 minutes of your time and will be audiotaped for transcription purposes using NVivo encrypted software and services.

There will be no direct or monetary benefit from participating in this study. The anticipated benefit of your participation in this study is your response will add to the limited body of research regarding dexterity examinations and their use in dental hygiene programs which will provide an expansion of knowledge for dental hygiene education programs.

If you have any questions about the research study, please contact either of the following individuals:

Loretta Mariano RDH, MSDH

Principle investigator

Doctor of Health Sciences Student

The University of Bridgeport, College of Health Studies

lmariano@my.bridgeport.edu

Dr. Mark Pitcher

Director of Health Sciences Inter-Professional Research

IRB Administrator

irb@bridgeport.edu.

This research has been reviewed according to University of Bridgeport IRB procedures for research involving human subjects.

ELECTRONIC CONSENT: Please select your choice below.

Clicking on the "agree" button below indicates that:

- you have read the above information
- you voluntarily agree to participate
- you are at least 21 years of age

If you do not wish to participate in the research study, please decline participation by clicking on the "disagree" button.

- ☐ agree
- ☐ disagree

SURVEY

Section 1: Demographics

Please answer the following demographic questions:

1. What is your gender?

- Male
- Female
- Other

- Prefer not to answer
2. What is your age range?
- 25-35
 - 36-45
 - 46-55
 - 56 and over
3. What is your position or title?
- Program director
 - Department chairperson
 - Dean
 - Other (please fill in the blank) _____
4. How long have you been employed in the position you selected in question #3?
- 1-3 years
 - 4-6 years
 - 7 or more years
5. In which state is your dental hygiene program located?
- Please fill in the blank _____
6. What degrees does your dental hygiene program offer? Please select all that apply.
- Entry-level AAS
 - Entry-level AS
 - Entry-level BS or BA
7. Does your dental hygiene program use a manual dexterity examination as a preadmission criterion for acceptance into the program?

- Yes
- No
- Not sure

Section 2: Interview

Please answer the following questions:

8. Would you be interested in participating in a brief face to face, Skype or Zoom interview at a mutually agreeable time?

- Yes
- No
- Maybe

9. May I contact you to discuss scheduling an interview time?

- Yes. Please provide the following:
 - i. Phone: _____
 - ii. Email: _____
- No

Appendix C - Semi-structured Interview Questions

1. Please describe or define in your own words what a manual dexterity examination is and what it is used for?
2. Do you have experience with the use of dexterity examinations as a preadmission criterion in a dental hygiene program?
 - a. If “yes”:
 - i. How many years did you use dexterity examinations as a preadmission criterion in a dental hygiene program?
 - ii. If I were watching a dexterity examination being implemented in your program, what would I see?
 - iii. Tell me about the positive and negative impacts implementing dexterity examinations has had as a whole.
 - On faculty
 - On students
 - On the program
 - iv. Explain any challenges you encountered, if any, when implementing dexterity examinations as a preadmission criterion?
 - v. If there were any challenges how did you overcome those obstacles?
 - b. If “no”
 - i. What are some reasons that may be preventing you from using dexterity examinations in your program as a preadmission requirement?
 - ii. Would you consider implementing dexterity examinations into your program as a preadmission requirement? Why or why not?

3. Do you consider dexterity examinations to be a valid and reliable tool to assess the manual dexterity or fine motor skills of dental hygiene applicants?
 - a. Why or why not?
4. Do you know of any other dental hygiene program directors who use dexterity examinations as part of their admissions process?
5. May I contact you if I have any follow up questions?
6. Would you be interested in reviewing the accuracy and completeness of our interview once the transcription is complete (member checking)?

Appendix D - Interview Protocol Sheet

Research Project: *Dexterity Examinations as a Preadmission Requirement in Dental Hygiene Programs*

Date of Interview:

Start time:

End time:

Participant:

Position held:

Years in the position:

Letter Assigned:

Interview Procedure

Introduce myself: My name is Loretta Mariano and I am a registered dental hygienist and doctoral student from the Doctor of Health Sciences Program at the University of Bridgeport in CT.

Thank the participant for agreeing to be interviewed: I want to thank you for participating in this study, for agreeing to this interview today, and I greatly appreciate your time.

State purpose of the study: The purpose of the study is to gain a deeper understanding of how dexterity examinations are used as a criterion for preadmission into dental hygiene programs, to uncover potential obstacles associated with their use, and determine if they are perceived as a valid and reliable tool to assess manual dexterity.

What will be done with the data to protect the confidentiality of the interviewee: To preserve participant anonymity you will be assigned a letter to be used in the data collection process to avoid linking responses to participants. No personal identifiers such as individual participant name or the name of the institutional employer will be used in any reports or publications

resulting from the study. The principal researcher is the only individual who will have access to participant recordings and data files collected in the study.

The estimated duration of the interview: 30-45 minutes

Explain the interview process: The interview will take place either face-to-face, via telephone, via Skype or Zoom. There are no right or wrong answers and you have the right to end your participation in the interview at any time without penalty. The audio of the interview will be recorded and transcribed at a later date for thematic analysis.

Do you have any questions about the interview?

Turn on recorder

Begin interview

1. Please describe or define in your own words what a manual dexterity examination is and what it is used for?

2. Do you have experience with the use of dexterity examinations as a preadmission criterion in a dental hygiene program?

Yes response

- a. How many years did you use dexterity examinations as a preadmission criterion in a dental hygiene program?
- b. If I were watching a dexterity examination being implemented in your program, what would I see?

- c. Tell me about the positive and negative impacts implementing dexterity examinations has had as a whole.
- On faculty
 - On students
 - On the program
- d. Explain any challenges you encountered implementing dexterity examinations as a preadmission criterion.
- e. How did you overcome those obstacles?

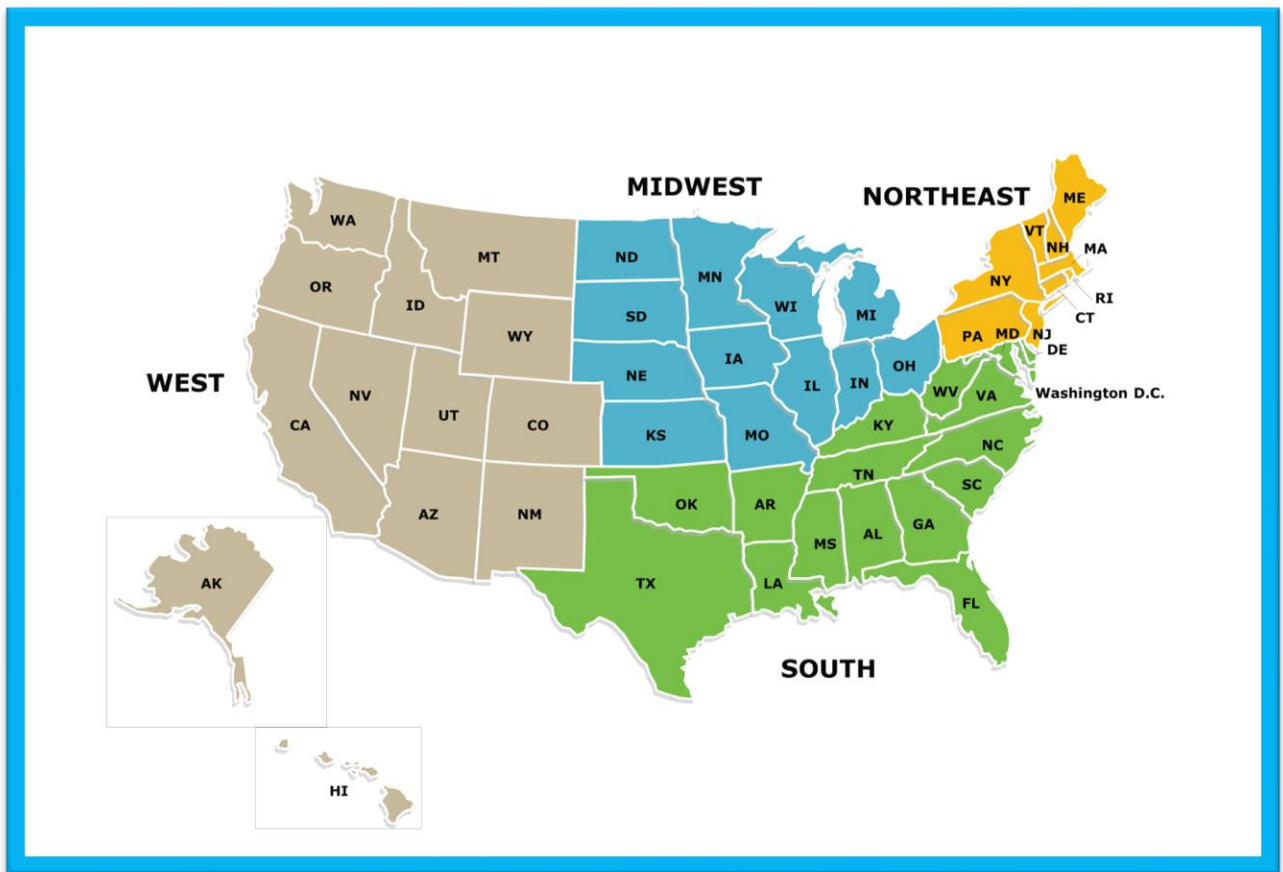
No response

- f. What are some reasons that may be preventing you from using dexterity examinations in your program as a preadmission requirement?
- g. Would you consider implementing dexterity examinations into your program as a preadmission requirement? Why or why not?

7. Do you consider dexterity examinations to be a valid and reliable tool to assess the manual dexterity or fine motor skills of dental hygiene applicants?
 - a. Why or why not?
8. Do you know of any other dental hygiene program directors who use dexterity examinations as part of their admissions process?
9. May I contact you if I have any follow up questions?
10. Would you be interested in reviewing the accuracy and completeness of our interview once the transcription is complete (member checking)?

Thank you for the generous donation of your time and participation in this interview.

Appendix E - Grouping of Participants by Geographic Location



Map depicting how geographic data will be categorized by four main regions within the U.S.

Image source: Taken from *US Region map templates* by Your Free Templates, (2017).